THE JOURNAL OF POLITICAL ECONOMY

PERIODICAL ROOM GENERAL LIBRARY UNIV. OF MICH.

OCT 24 1932

Volume XL OCTOBER 1932 Number 5

Edgeworth's Taxation Paradox and the Nature of Demand and Supply Functions — *Harold Hotelling* — 577

The Theory of Population: Some Questions of Quantity and Quality — *Alfred Plummer* — 617

Holland, Switzerland, and Belgium and the English Gold Crisis of 1931 — *Willard Hurst* — 638

Technological Development of the American Pottery Industry — *H. J. Stratton* — 661

The Economic Significance of Brokers' Loans — *Wilford J. Eiteman* — 677

Capital Production and Consumer-Taking: A Further Word — *J. M. Clark* — 691

Capital Production and Consumer-Taking: A Final Word — *Ragnar Frisch* — 694

Book Reviews (See inside front cover) — 695

Books Received — 720

THE UNIVERSITY OF CHICAGO PRESS
CHICAGO, ILLINOIS, U.S.A.

October 1932 Volume XL, No. 5

THE JOURNAL OF POLITICAL ECONOMY

EDITED BY JACOB VINER AND F. H. KNIGHT, WITH THE CO-OPERATION OF THE OTHER MEMBERS OF THE DEPARTMENT OF ECONOMICS OF THE UNIVERSITY OF CHICAGO

BOOK REVIEWS

A Reply (Rogin), 695.—Graham, *Exchange, Prices, and Production in Hyper-Inflation: Germany, 1920–1923* (Burns), 696.—Wilson, *Capital Imports and the Terms of Trade Examined in the Light of Sixty Years of Australian Borrowings* (Beach), 702.—Wood, *Borrowing and Business in Australia* (Beach), 707.—Suranyi-Unger, *Economics in the Twentieth Century* (F. H. Knight), 708.—Gray, *The Development of Economic Doctrine* (F. H. Knight), 711.—Southworth, *The French Colonial Venture* (M. M. Knight), 713.—Egner, *Der Sinn des Monopols in der gegenwärtigen Wirtschaftsordnung* (Leontief), 714.—Logan, Jr., *Stabilization of the Petroleum Industry* (Stocking), 717.

The Journal of Political Economy is published bi-monthly, by the University of Chicago at the University of Chicago Press, 5750 Ellis Avenue, Chicago, Illinois. The subscription price is $5.00 per year; the price of single copies is $1.00. Orders for service of less than a half-year will be charged at the single-copy rate. ¶ Postage is prepaid by the publishers on all orders from the United States, Mexico, Cuba, Porto Rico, Panama Canal Zone, Republic of Panama, Dominican Republic, Canary Islands, El Salvador, Argentina, Bolivia, Brazil, Colombia, Chile, Costa Rica, Ecuador, Guatemala, Honduras, Nicaragua, Peru, Hayti, Uruguay, Paraguay, Hawaiian Islands, Philippine Islands, Guam, Samoan Islands, Balearic Islands, Spain, and Venezuela. ¶ Postage is charged extra as follows: for Canada, and Newfoundland, 25 cents on annual subscriptions (total $5.25); on single copies 4 cents (total $1.04); for all other countries in the Postal Union, 55 cents on annual subscriptions (total $5.55); on single copies 9 cents (total $1.09). ¶ Patrons are requested to make all remittances payable to the University of Chicago Press in postal or express money orders or bank drafts.

The following are authorized agents:

For the British Empire, except North America, India, and Australasia: The Cambridge University Press, Fetter Lane, London, E.C. 4, England. Prices of yearly subscriptions and of single copies may be had on application.

For Japan: The Maruzen Company, Limited, Tokyo.

For China: The Commercial Press, Ltd., Paoshan Road, Shanghai. Yearly subscriptions, $5.00; single copies, $1.00, or their equivalents in Chinese money. Postage extra, on yearly subscriptions 55 cents, on single copies 9 cents.

Claims for missing numbers should be made within the month following the regular month of publication. The publishers expect to supply missing numbers free only when losses have been sustained in transit and when the reserve stock will permit.

Business correspondence should be addressed to The University of Chicago Press, Chicago, Ill.

Communications for the editors and manuscripts should be addressed to the Editors of THE JOURNAL OF POLITICAL ECONOMY, The University of Chicago, Chicago, Ill.

The articles in this journal are indexed in the *Reader's Guide to Periodical Literature*, New York, New York.

Applications for permission to quote from this journal should be addressed to The University of Chicago Press, and will be freely granted.

Entered as second-class matter January 16, 1893, at the post-office at Chicago, Illinois, under the Act of March 3, 1879.

Acceptance for mailing at special rate of postage provided for in Section 1103, Act of October 3, 1917, authorized on July 28, 1918.

[PRINTED IN U.S.A.]

THE JOURNAL OF
POLITICAL ECONOMY

Volume 40 OCTOBER 1932 *Number 5*

EDGEWORTH'S TAXATION PARADOX AND THE NATURE OF DEMAND AND SUPPLY FUNCTIONS[1]

1. A tax may result in buyers paying less, page 577.—2. A discontinuous example, page 579.—3. Is Edgeworth's phenomenon improbable? page 581.—4. The nature of supply and demand functions for single commodities, page 583.—5. Demand and supply functions for several commodities, page 590.—6. Suggestions for statistical studies of demand and supply, page 598.—7. Taxation under free competition, page 600.—8. Conditions for Edgeworth's phenomenon with monopoly, page 608.—9. Three or more commodities, page 614.—10. Summary, page 615.

1. A TAX MAY RESULT IN BUYERS PAYING LESS

That a tax imposed on the seller of a monopolized article may lead to an actual lowering of the price to the buyer has been shown by F. Y. Edgeworth.[2] His example was of a railway supplying two classes of passenger service at different prices and, unhindered by governmental interference, setting its rates so as to make its own profit a maximum. When the company is compelled to pay a tax on each first-class ticket, it finds it profitable, in Edgeworth's example, to reduce rates on both classes of accommodations. Regarding this paradoxical conclusion, Professor Seligman writes:[3]

[1] Presented at a joint meeting of the Econometric Society and Section K of the American Association for the Advancement of Science, at New Orleans, January 1, 1932.

[2] *Papers Relating to Political Economy* (London, 1925), I, 132, 143 ff., and II, 401.

[3] *Shifting and Incidence of Taxation* (4th ed.; 1921), p. 214 n.

> The mathematics which can show that the result of a tax is to cheapen the untaxed as well as the taxed commodities will surely be a grateful boon to the perplexed and weary secretaries of the treasury and ministers of finance throughout the world!

Edgeworth regarded the diminution of price as a result of a tax as a phenomenon of monopoly. We shall see that even under competition, whether "free" competition or of the duopolistic variety, a decrease of prices may result from a tax on the sellers.

It must not, of course, be supposed that the lowering of prices with imposition of a tax will occur in all cases; this would not only fly in the face of common sense (which is singularly unreliable in such matters) but would be at variance with the case of a monopolist controlling articles for which there is no joint demand or joint cost, where a familiar demonstration shows that the price of the taxed article will not be diminished but will in general increase. For some pairs of related demand functions a tax on one commodity will cause both to increase in price; for others, one commodity will increase and the other decrease in price. To survey the boundaries of the third class, for which both commodities will decrease in price, when the seller pays a tax, is one of our primary objects.

Some contributions to the theory of demand and supply functions, suggested by the study of the conditions necessary for the existence of Edgeworth's phenomenon but really of much broader application, are embodied in Sections 4, 5, and 6.

The fact that Edgeworth's phenomenon, even for the monopolistic case for which he established its possibility, is little known and less understood may perhaps be attributed to the peculiar forms of his demand functions as much as to the fact that the argument is essentially mathematical. It is natural to think of a railway company setting its rates, which we shall denote by p_1 and p_2, and then letting its customers decide how many rides they will take. If we let q_1 be the number of first-class, and q_2 the number of second-class, journeys, it is natural therefore to think of q_1 and q_2 as functions of p_1 and p_2. Edgeworth, however, did not give these functions explicitly, but gave the prices which the company could obtain as functions of q_1 and q_2. To be sure, his equations can theoretically be solved for q_1 and q_2, but they are of such

complex forms that the solution in intelligible terms is virtually impossible. In Section 8 we shall give an example in which q_1 and q_2 are simple functions of p_1 and p_2.

Edgeworth used continuous demand functions and supposed the tax infinitesimal. These conventions are very useful, and after the next section we shall adhere to them. But to show that neither is essential, and to illustrate more clearly the phenomenon, we shall first give an example with discontinuous demand functions and a very large tax.

The scope of application is widened, first, by the fact that a change in the cost of production will have the same effect as a tax; and second, by the fact that a bounty may be treated as a negative tax. Thus, a bounty paid to a seller (whether a monopolist or not) in proportion to his sales of an article may lead him to increase the price of this article, and also the prices of other things which he sells. Furthermore, the results derived for a seller's monopoly may be applied, *mutatis mutandis*, to a buyer's monopoly. Finally, the reasoning may all be applied to railway and utility rates, which essentially are taxes. In Section 7 we derive a criterion for obtaining revenue with minimum burden.

2. A DISCONTINUOUS EXAMPLE

A railway company supplies first- and second-class transportation between two points and has the following potential customers:

Group A, consisting of 450 persons who will ride first class if this does not cost as much as $5.00 above the second-class fare, or second class if the difference is $5.00 or more, but who will not pay more than $12.00 for a first-class or $7.00 for a second-class ticket.

Group B, 40 persons who will ride first class if the fare is $11.00 or less, but whose distaste for the second class is so profound that they will not use it at any price.

Group C, a mass of 900 who will ride second class if this fare is $8.00 or less, but who will not pay appreciably more for a first-class than for a second-class ticket.

Group D, 200 persons who will travel second class if the fare is

not more than $6.00, and who will not pay more even for first-class tickets.

Without affecting the principle involved, we assume that there is no cost of production, that the company will set rates which will maximize its profits, and that the prospective passengers will each take one trip, if any, per unit of time. If there is an extra cost to the company, of, say, $10.00, for each passenger, each fare mentioned may be increased by $10.00 and the argument left unaffected.

Under these conditions (in the absence of cost), the first-class rate will be set at $12.00 and the second-class at $8.00. Group A will then ride first class, Group C second class, and Groups B and D not at all. The revenue will be $5,400+$7,200=$12,600. It is easy to see that this is the maximum possible revenue, losses being incurred if either fare is lowered or raised.

A tax of $7.00 for each first-class ticket is now imposed upon the railway company, those of the second class not being taxed. Since the maximum net profit from a first-class ticket is now less than the second-class rate which will bring about all possible travel in this class, the company's interests call strongly for the diversion of its first-class riders to second class. This cannot, however, be accomplished without reducing the second-class fare to $7.00 or less, because of the strong preference of Group A for the first class. But if the second-class fare is to go so low, the question comes into view of lowering it still further so as to bring in Group D. At first this reduction of second-class fare from $7.00 to $6.00 in order to gain 200 extra passengers seems unprofitable because of the loss of $1.00 on each of the 1,350 in Groups A and C, while the new business amounts only to $1,200. Thus, a loss of $150 would seem to attend the lowering of this fare from $7.00 to $6.00. However, the 40 persons in Group B, in spite of their dislike of second class, will have an influence upon it. If the first-class fare is lowered to $11.00, out of which the $7.00 tax is paid, Group B will yield a net profit of $160. In order to get this, Class A must be prevented from returning to the first class, and this necessitates the lowering of the second-class fare to $6.00. Thus, the apparent $150 loss from this final lowering of the second-class fare is more than offset by the $160 from Group B.

By thus lowering both its rates, the company obtains a profit of $160 from the first class and $9,300 from the second class, a total of $9,460. At the old $12.00 and $8.00 schedule, Group A would have yielded a net profit of $2,250 and Group C $7,200, a total of $9,450. The imposition of the tax therefore means that the company can, by decreasing both rates, make its loss $10.00 less than it would be at the old rates.

3. IS EDGEWORTH'S PHENOMENON IMPROBABLE?

The construction of demand functions displaying the decrease of both prices with the taxation of one commodity has, for the case of monopoly, been difficult and laborious. Many examples have been tried, both by the present author and by others, with the confident expectation of illustrating Edgeworth's phenomenon, only to prove in the end to be unsuitable. This tends to suggest that the decrease of price with taxation may not be very common. However, the failure of the attempted examples was most frequently in the contravention by the proposed demand functions of some condition which demand functions ought to satisfy, rather than in failure to produce decreases of price with the tax.

Thus, if the quantities which will be taken at prices p_1 and p_2 are given by

$$q_1 = 32 - 7p_1 + 16p_2, \qquad q_2 = 32 + 8p_1 - 24p_2,$$

and if the commodity corresponding to the subscript 1 is taxed at rate t, it is easy to see that, if cost of production is negligible, the prices which will maximize the monopoly profit are

$$p_1 = 24 - \frac{t}{2}, \qquad p_2 = \frac{38}{3} - \frac{7t}{12}.$$

Both these prices diminish as the tax increases.

Against this example, which I showed to Professor Holbrook Working several years ago, he made two decisive objections. In the first place, it is unreasonable to suppose that an increase in p_1 should increase q_2 more than it decreases q_1; if railway fares are in question, the increase in the first-class fare will presumably increase second-class travel only by diverting to the second class a

part of the first-class business, the remainder perhaps refusing to ride at all. Objections of this kind will be avoided if the conditions to be discussed in Section 5 are satisfied. The other objection is that the maximizing p's make q_2 negative when $t=0$.

These and other traps must be avoided in the construction of examples. It is therefore necessary, in order to examine Edgeworth's paradox, to determine just what conditions must be satisfied, and also what conditions are likely to be satisfied, by demand functions. This we shall undertake in Section 5. Indeed, as Edgeworth remarked, the chief use of paradoxes is to stimulate a more critical examination of what is already supposed to be known. It is easy to fall into the error of supposing that demand functions for several commodities need satisfy no conditions except the decrease of demand for each commodity when its price increases.

In addition to the conditions which demand functions must necessarily satisfy, there are others which they may be expected to satisfy approximately. These, which may help to answer the question arising in statistical inquiries as to the shape of the demand curve for a single commodity, will be discussed in Section 4.

Edgeworth was interested in the question whether demand functions leading to the phenomenon he discovered are *probable*. In the complete absence of empirical evidence on this point, the only possible type of investigation seems to consist in determining whether, for demand functions involving a finite number of parameters, the condition that Edgeworth's situation shall obtain involves a decrease in the number of parameters. If there are k parameters in a set of demand functions for any number of commodities, each of these sets of functions may be represented by a point in a k-dimensional region. A portion of this region corresponds to demand functions such that the imposition of a small tax on a particular commodity will result in a diminution of the prices of all the commodities considered. It is natural to ask: How large a fraction of the whole region is occupied by this subregion? Unfortunately, no consistent answer is possible, because of the lack of uniqueness in the choice of the parameters; that is, if we should try to compare the k-dimensional volume of the subregion with that of the whole region, we should have to face

the possibility of a transformation of the parameters which should change the ratio. But if the region occupied by the points corresponding to demand functions possessing Edgeworth's property is of fewer than k dimensions, their probability may be said to be zero.

Thus, the only answer which at present can confidently be given to the question of the importance in actual economic life of the kind of situation portrayed by Edgeworth turns upon the question whether the number of degrees of freedom of demand functions is decreased when the requirement of lowering of prices with taxation is imposed. We shall see that this is not the case. Not equations, but inequalities, express the phenomenon; and these, if consistent, do not reduce the number of degrees of freedom. There is no basis known at present for denying that Edgeworth's phenomenon may pertain to a large proportion of ordinary situations, or for affirming that it is, in his language, a mere *curiosum*. It is quite possible, so far as the evidence now goes, that in many practical questions of governmental policy the best expert advice has gone astray because of reliance on the simplified cases treated in the textbooks, in which the correlation of demand for different commodities is neglected. Factual investigations of particular sets of commodities may some day produce more definite knowledge of the effects of taxes upon prices. For a random case, the purely deductive reasoning now available fails to tell us definitely whether it is more probable that a tax will increase or decrease the price paid by buyers.

In order to make sure that we have examined all the limitations which may reasonably be applied to demand and supply functions in general, we shall digress to consider some general properties, chiefly of interest on their own account rather than for their bearing upon Edgeworth's phenomenon.

4. THE NATURE OF SUPPLY AND DEMAND FUNCTIONS FOR SINGLE COMMODITIES

It has often been said that choosing a type of curve to fit to data is a more serious statistical problem than the process of fitting itself. In the statistical determination of demand and sup-

ply curves it may therefore be worth while to observe that these curves essentially represent cumulated frequency distributions. They are simply ogives.

To examine the histogram corresponding, for example, to a supply function, we may plot the price p horizontally (Fig. 1) and take as ordinate the value of the *slope* $q' = dq/dp$ of the supply curve. The area inclosed by this (the unbroken) curve, the p-axis, and any two ordinates represents the additional amount Δq which will be put on the market when the price is increased from the

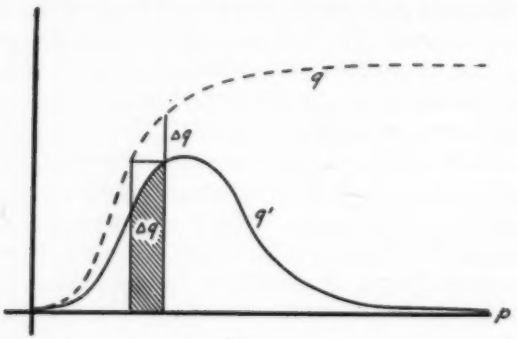


FIG. 1

abscissa of the left-hand vertical line to the abscissa of the other vertical line. This increase of supply Δq is also represented by the difference between the corresponding ordinates of the dotted supply curve. Here we are dealing with a long-run effect, a matter of economic statics, not with transitional phenomena. In speaking of increases of price and quantity, we merely contrast two hypothetical permanent situations.

Now the frequency distributions of most important variates have certain properties arising from the influence upon the variate of many causes which are to some extent independent of one another. Usually there is a concentration about a central value, with a rather smooth decline on each side of this value. Commonly there appears to be contact of high order with the axis at each end. Very often there is a rough approximation in form to the normal error curve. There are good reasons to expect these prop-

erties. Indeed, some of the causes acting will tend to make the variate large, and some will tend to make it small, in far more cases than those in which all the causes happen to act in the same direction.

Consider, for example, the variation of the amount of milk brought into a city in relation to the price. An increase in the city price will tend to increase production by extending the area from which milk is shipped, by diverting to milk production a larger proportion of the area within the region from which milk is

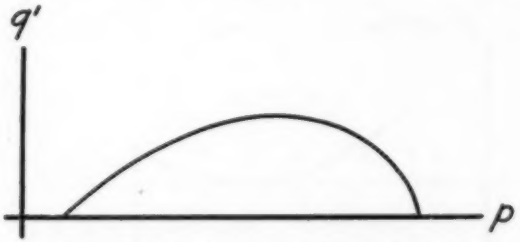


FIG. 2.—Marginal milk production corresponding to change of area. First approximation to differential supply curve.

shipped, by encouraging the use of more labor and feed in the better care of cows, and in other ways. Let us consider first the increase of production by extension of area, supposing the simplest possible case, with transportation cost proportional to straight-line distance. For very small prices, milk can come only from a small circle about the city. The marginal increase dq in quantity resulting from an increase dp in the price will come from a strip of fixed breadth running around the circle. The area of this narrow strip, and therefore dq, will be proportional to the radius, and therefore to the excess of p above the minimum price at which milk can be produced. If, therefore, we plot $q' = dq/dp$ as a function of p, and suppose that all factors other than producing area remain constant, we shall have a graph (Fig. 2) which rises in a linear fashion from the left. It cannot rise indefinitely with increase in price, since the total area from which it is physically possible to ship milk is limited. If larger and larger concentric circles about the city are drawn, a stage will be reached at which

only a portion of the circumference lies within a potential milk-producing area. Corresponding to this, our graph will, as we proceed from the left, rise less rapidly. It will at last drop gradually to zero.

Within a particular zone about the city, the land which will be devoted to milk production will depend upon the price in a manner which may perhaps be illustrated by Figure 3, in which the ordinate represents the differential increment in the shipment of milk from this zone on account of the increase in dairy land corre-

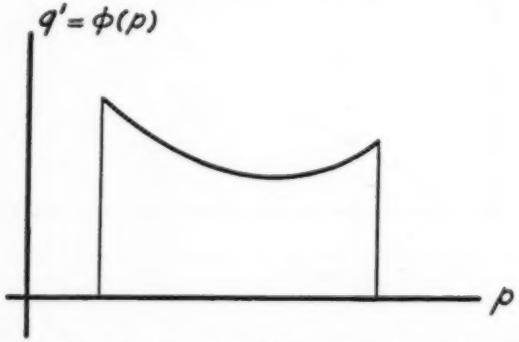


FIG. 3.—Marginal milk production within a particular zone due to change in land devoted to dairying.

sponding to a fixed small increment of price, added to the variable price represented by the abscissa. In order to display the approach to normality with compounding, we have arbitrarily represented this distribution as of a form much more removed from that of the normal curve than would probably be the case.

Now if this or some similar distribution of land in dairying in relation to price be attributed to each zone, and if we consider the variation of milk shipments resulting from the *two* variables—total area, and proportion of land in dairying—we shall obtain a new curve of distribution (Fig. 4), which may be derived mathematically from those of Figures 2 and 3. We shall now show that the relationship is identical with that between the frequency distribution of the sum of two variates and the separate frequency distributions of these variates.

Let the equation of the curve in Figure 2 be $q' = f_1(p)$. If, in accordance with our first approximation, which supposes 100 per cent of the land in the region devoted to dairying, we suppose unit quantity of milk produced on each unit of land, and if, also, the transportation cost per unit distance is unity, this means that $f_1(r)$ is the length of the arc within the possible milk-producing region of a circle of radius r.

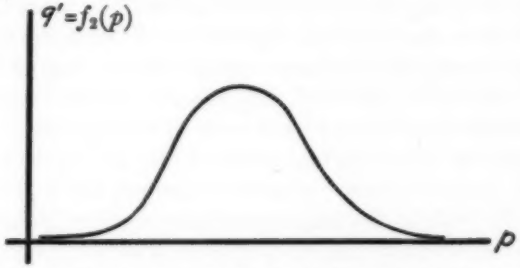


FIG. 4.—Second approximation to the differential supply curve

As a second approximation, let us suppose that within each zone a fraction $\phi(p_1)$ of the land will be devoted to dairying when the net price obtainable, after paying for transportation, is p_1. Then, since $p_1 = p - r$, the total amount of milk produced will be

$$f_2(p) = \int f_1(r)\phi(p-r)dr ,$$

the integration being over the range for which both factors are positive. But this is exactly the formula for finding the frequency function $f_2(p)$ for the sum p of two independent variates, r and p_1, whose respective frequency functions are $f_1(r)$ and $\phi(p_1)$.

The resulting frequency function $f_2(p)$ (Fig. 4) will be the derivative of the second approximation to the supply curve. It will have contact with the p-axis of higher order than either of the curves of Figures 2 and 3 from which it was obtained. The general theory of the compounding of frequency functions indicates that in other ways also it will resemble the normal frequency curve more than do the distributions which give rise to it.

If we consider a third variable cause of milk production which responds to price, such as the amount of labor put into the care

of the cows, we may obtain similarly a third approximation $f_3(p)$ to the differential supply curve; and this will still more closely resemble the normal error curve. There is, to be sure, an assumption analogous to that of independence in the probability theory. This assumption, in obtaining the second approximation, is that the distribution $\phi(p_i)$ is the same for all zones; for the third approximation, it would be assumed that any given residuum of price left after paying for transportation and rent would have an effect in inducing the expenditure of additional labor which is felt in equal proportions in each of the marginal productions previously dealt with. However, the limitation upon the generality of the conclusion that the normal error curve is approached is not very seriously limited by this consideration. Indeed, the work of Markoff, S. Bernstein, and others has shown clearly that the limit theorem of probability remains true in spite of very considerable relaxations of the requirement of independence.

Perhaps a more serious difficulty is in the requirement of the limit theorem of probability that the constituent variables shall have variances of the same order of magnitude. How much this will modify the conclusion that something like the normal distribution is approached must be left for investigation in individual cases. Certainly it will not detract from our confidence in the fundamental proposition that the curve of differential supply as a function of price will have contact of high order with the axis of price at the ends of its range. The exact location of the limits of price outside of which no change of price can affect the supply is unimportant. In many cases no great error will be made if the range is taken as infinite.

The supply curve usually discussed will thus have a shape which can be determined in its general outlines on the basis of pure theory. If p is measured horizontally, this curve may be expected to rise from zero more and more rapidly until a point of inflection is reached; thereafter it will approach asymptotically, or else attain, a horizontal level which it cannot exceed. The ideal curve will satisfy the differential equation

$$\frac{dq}{dp} = e^{-(ap^2+2bp+c)}.$$

The argument holds similarly for demand functions. As a price diminishes, different types of demand are disclosed. Cheap wheat is fed to chickens, cheaper wheat to cattle, and still cheaper wheat to stoves. For any one time, however, the price of wheat varies greatly in different places. If at different places there is the same demand function for local consumption in terms of the local price, the total demand will be represented by a compound obtained by methods similar to those used above for supply functions. A curve of differential demand may therefore be expected to have something of the form of the normal error curve, while the demand curve in the ordinary sense, representing the area under the differential demand curve to the left of a particular ordinate, will decline in such a way that the approach to zero for very high prices is extremely gradual. We cannot, of course, assert that the integral of the normal probability curve will fit every supply or demand curve closely; but the reasons just reviewed seem to raise a very considerable presumption of an approximate fit.[4]

The integrated normal distribution may thus reasonably be used to represent both supply and demand functions. This function may indeed find many applications in economics. The trend of a time series may perhaps be somewhat of this character. A historic event (for example, an invention) causes an increase in an economic variable; but this does not take place all at once. The old methods survive in different places and in varying degrees for some time. Gradually they give way, and the curve of sales of the new commodity goes up. The change takes place at first slowly, then more rapidly, and finally, when it is almost complete,

[4] Since the foregoing theoretical derivation of the form of a supply curve was written, I learn that curves resembling this general form have been obtained statistically for potatoes and for cabbages by Dr. Louis H. Bean in the *Journal of the American Statistical Association*, XXV (1930), 428–39, and in the *Proceedings of the Seventeenth Annual Meeting of the Potato Association of America* (December, 1930), pp. 53–61. Professor Henry Schultz, to whom I am indebted for remarking on the work of Bean, also observes, apropos the next paragraph, that the integral of the normal curve was used as a trend for the first time by the late Professor R. A. Lehfeldt ("The Normal Law of Progress," *Journal of the Royal Statistical Society*, LXXIX [1916], 329–32). Lehfeldt fits the integrated normal curve to British population and trade and to German birth-rates. Another method of deriving equations of demand functions by means of probability is given by T. H. Brown in the *Journal of the American Statistical Association* for June, 1925.

slowly again. The observed fact that the logistic, or hyperbolic tangent curve, which is of much the same form as the integrated normal curve, approximates many series suggests that something of this sort represents the rationale of economic and social changes.

5. DEMAND AND SUPPLY FUNCTIONS FOR SEVERAL COMMODITIES

The quantities which buyers will take of n commodities when the prices of these commodities are $p_1, \ldots, p_n$ are thought of as given by n expressions

$$q_i = F_i(p_1, \ldots, p_n) \qquad (i = 1, 2, \ldots, n) . \tag{1}$$

In general it may be assumed that these equations are capable of solution, giving for the prices

$$p_i = f_i(q_1, \ldots, q_n) \qquad (i = 1, 2, \ldots, n) . \tag{2}$$

Our present concern is to find what conditions will be satisfied by these functions.

Consider first an entrepreneur. By using quantities $q_1, \ldots, q_n$ of the several commodities (in which term we include, for convenience, services), he succeeds in making sales amounting, in money, to

$$u = u(q_1, \ldots, q_n) .$$

Since he spends $p_1q_1 + p_2q_2 + \ldots + p_nq_n$, his net profit will be

$$u - p_1q_1 - p_2q_2 - \ldots - p_nq_n .$$

If he regards the prices of the articles he buys as fixed, he will therefore make his profit a maximum if he chooses the q's in such a way that

$$\frac{\partial u}{\partial q_i} = p_i , \qquad (n \text{ equations}; \quad i = 1, 2, \ldots, n) \tag{3}$$

provided the inequalities on the second derivatives which assure a true maximum are satisfied.

Not only entrepreneurs, but also purchasers of goods for their own consumption, tend to proceed according to the same principle. To be sure, the buyer may not have in mind a quantity so definite as net profit to maximize, and may behave in an irregular and inconsistent manner. But so far as he weighs in a consistent manner the relative utilities of various goods, considering whether one prospective purchase is "a better bargain" than another, it is clear that there is a function u of the quantities purchased which he is trying to make a maximum. For each such function, (3) and the appropriate inequalities will hold. Consequently, (3) will hold when the total of the u's and the total consumption of q_i's are substituted. The adjustment of prices according to the market means that the p's in (3) may be regarded as functions of the q's, in spite of individual buyers considering the p's fixed. Hence, upon differentiating (3) with respect to q_i, interchanging i and j, and subtracting, we obtain:

$$\frac{\partial p_i}{\partial q_j} = \frac{\partial p_j}{\partial q_i}, \tag{4}$$

which must be satisfied by (2) for every combination of i and j, if we neglect irrational and inconsistent purchasing and cases in which the buyer cannot find a definite criterion for distinguishing comparative values. It may be remarked that the equations (4) are a sufficient, as well as a necessary, condition for the existence of a function u satisfying (3), and are therefore known as "integrability conditions" for the functions (2).

A true maximum, rather than a minimum or a minimax, will occur if the quadratic form

$$\sum\sum \frac{\partial^2 u}{\partial q_i \partial q_j} x_i x_j \tag{5}$$

is negative definite; that is, if it takes only negative values whenever real numbers, not all zero, are put for the x's. This will be true if

$$\frac{\partial p_i}{\partial q_i} < 0, \quad \frac{\partial(p_i, p_j)}{\partial(q_i, q_j)} > 0, \quad \frac{\partial(p_i, p_j, p_k)}{\partial(q_i, q_j, q_k)} < 0, \ldots, \tag{6}$$

the second and later of these quantities being Jacobian determinants, whose signs are to alternate.

The first of the inequalities (6) expresses the familiar property of demand curves of sloping downward. The others are not so familiar, but are similar to a set of conditions on a utility function obtained by V. Pareto in the *Encyclopédie des sciences mathématiques*, Tome I, Vol. IV, Fasc. 4.

If we had set out to make a utility function u of the q's a maximum subject to the condition that the total expenditure

$$p_1q_1+p_2q_2+\cdots\cdots+p_nq_n$$

must have a constant value, we should have obtained, instead of (3),

$$\frac{\partial u}{\partial q_i}=\lambda p_i\,, \tag{3'}$$

where λ, the "marginal utility of money," is a function of the q's. This proportionality of prices to marginal utilities is familiar. The argument given above attains a more specific result, obviating the factor λ by restricting attention to those cases in which money is spent, as the saying is, to make money. This category of expenditures is very large, including not only all the articles commonly classed as producers' goods but such items as the haircuts and trousers-pressing paid for by the salesman in order to increase his sales. It includes even a good deal of food, clothing, and entertainment which are consumed, at least in part, with a view to making more money.

It is only when the money expenditure is absolutely fixed that the factor of proportionality λ comes into play. In such cases the relations (3) and (4) may not hold accurately. In place of (4) there will be the looser conditions

$$p_k\left(\frac{\partial p_i}{\partial q_j}-\frac{\partial p_j}{\partial q_i}\right)+p_i\left(\frac{\partial p_j}{\partial q_k}-\frac{\partial p_k}{\partial q_j}\right)+p_j\left(\frac{\partial p_k}{\partial q_i}-\frac{\partial p_i}{\partial q_k}\right)=0\,. \tag{4'}$$

These are satisfied if (4) is satisfied, but the converse is not necessarily true. The second-order conditions will also be modified.

For the purposes of the present paper we prefer to consider

functions satisfying the stricter conditions (3). If cases of Edgeworth's phenomenon can be found for them, such cases belong *a fortiori* to the wider class also.

The difference between the conditions represented by (3) and by (3′) is brought out by the case of a rising demand curve for bread sometimes supposed to occur. A rise in the price may so impoverish the poorer classes that they cannot afford other more costly foods and must eat more bread. The inverted form of the demand curve is explained by variation of the marginal utility of money λ. We are not here inquiring whether such conditions exist; we are only insisting that, as they are atypical, we shall not depend upon them in giving examples of Edgeworth's taxation phenomenon. But for the great bulk of commercial transactions it may be assumed that the buyer will increase the total of his purchases if, by so doing, he can increase his profits. In such cases (3) and (4), not merely (3′) and (4′), will be satisfied.

Our preference for (3) and (4) over (3′) and (4′) may be explained by imagining a milling company whose stockholders have delivered this mandate to the management: "You shall spend exactly one million dollars during the coming year. You may apportion this as you please in purchasing the various cereals and in other expenses. We hope you will make us as large a profit as possible, but we absolutely insist that the total of the checks you write shall not be more nor less than one million dollars." The management of this company is in the same position as an "economic man" trying to make his ophelimity u, a function of $q_1, \ldots, q_n$, a maximum, while keeping $p_1q_1 + \cdots + p_nq_n$ fixed. That is the problem which gives rise to (3′) and (4′). Apart from rentiers, most buyers, even in their personal transactions, resemble our hypothetical stockholders less than the more common stockholder, who is far better pleased if the net profit $u - \Sigma pq$ (where u represents gross receipts and Σpq expenses) is a maximum than if Σpq is restricted by some other consideration.

The derivatives of the q's with respect to the p's obtained from (1) will also, in the wide class in which λ is constant, satisfy relations analogous to (4) and (6). Indeed, it is known[5] that $\partial q_i/\partial p_j$

[5] Cf., for example, Eisenhart's *Riemannian Geometry*, p. 2, or books on advanced calculus.

is the ratio of the cofactor of $\partial p_j/\partial q_i$, in the determinant of the derivatives such as the latter, to the value of this determinant. Since, by (4), this determinant is symmetric,[6] it follows that

$$\frac{\partial q_i}{\partial p_j}=\frac{\partial q_j}{\partial p_i}. \tag{7}$$

Just as we have a utility (or profit) function u of the quantities consumed whose derivatives are the prices, there is, dually, a function of the prices whose derivatives are the quantities consumed. The existence of such a function, which heretofore does not seem to have been noticed, is assured by (7). On the basis of physical analogies we may call this the "price potential."

From the values of the derivatives of the p's with respect to the q's alluded to above, it is possible, with the help of the theorem on minors of adjoint determinants,[7] to express the Jacobians of the p's with respect to the q's in terms of those of the q's with respect to the p's. It will then follow from (6) that

$$\frac{\partial q_i}{\partial p_i}<0\,, \qquad \frac{\partial(q_i,\, q_j)}{\partial(p_i,\, p_j)}>0\,, \qquad \frac{\partial(q_i,\, q_j,\, q_k)}{\partial(p_i,\, p_j,\, p_k)}<0\,, \ldots\ldots \tag{8}$$

A consequence of these relations is that if the price potential be expanded about any set of values of the prices, the terms of second

[6] As this paper goes to press, I learn from Professor Henry Schultz, to whom I am grateful for several other comments and suggestions also, that statistical demand equations for agricultural commodities have been worked out in his laboratory, which do not satisfy the integrability conditions (7). Indeed, he states, $\partial q_i/\partial p_j$ differs in several instances from $\partial q_j/\partial p_i$, not only in absolute value but in sign, and with sufficiently small standard errors. His equations involve time explicitly, e.g., $q_i=F_i(p_1, \ldots, p_n, t)$, but the additional variable t should not in itself spoil the integrability conditions if the situation is regarded as a succession of static states. If these results are definite enough to overcome the treacherous difficulties of inference from time series, they constitute a most striking phenomenon, for which some explanation is required. The difference in sign is particularly remarkable. It is as if lower bus rates should increase travel in the same direction on a railroad, though lowering the railroad rate takes away business from the buses. Perhaps consumers in buying these commodities behave in a very different way from what they would if their knowledge and reasoning power were perfect; or changes in fashion, or some other dynamical effect, may have obscured the situation.

[7] M. Bocher, *Introduction to Higher Algebra*, p. 31.

degree form a negative definite quadratic form. Thus, for two commodities, if the price potential be thought of as the height of a surface above the plane of p_1 and p_2, the surface will be concave downward. A utility surface similarly plotted over the plane of q_1 and q_2 will likewise be concave downward. The meaning of this criterion has not always been realized. It is not satisfied by one of the utility surfaces depicted by Professor Irving Fisher,[8] a surface which can only represent a state of affairs in which a person may be so oversupplied with a commodity that he will pay to have it taken away.

Let us revert to the hypothetical demand functions mentioned in Section 3, which are of the form

$$q_1 = a - bp_1 + cp_2 , \qquad q_2 = a' + b'p_1 - c'p_2 ,$$

with a, b, c, a', b', c' positive and $b < b'$. Professor Working's objection that an increase in p_1 should not increase q_2 more than it decreases q_1 is applicable to the special case of passenger tickets but not to commodities in general, for in general we could change the units of measure so as to make $b > b'$. Expressing the quantity and price of the first commodity in terms of a new unit by Q_1 and P_1, let us suppose the ratio of units such that $q_1 = hQ_1$. Then, since p_1q_1 must equal P_1Q_1, we shall have $p_1 = P_1/h$. The transformed demand functions are:

$$Q_1 = \frac{a}{h} - \left(\frac{b}{h^2}\right)P_1 + \left(\frac{c}{h}\right)p_2 ,$$

$$q_2 = a' + \left(\frac{b'}{h}\right)P_1 - c'p_2 .$$

If the new unit is such that the criterion suggested by Working is satisfied, we must have

$$\frac{b}{h^2} > \frac{b'}{h} .$$

[8] *Mathematical Investigations in the Theory of Value and Prices*, p. 70, Fig. 19.

But the same criterion can be applied to show that, in the same units, an increase in p_2 should affect q_2 more than Q_2; whence

$$c' > \frac{c}{h}.$$

Since all the quantities appearing in these two inequalities are positive, we may multiply them member for member, obtaining

$$bc' - b'c > 0.$$

But this is precisely the second of the conditions (8), which, in view of (7), may be written

$$\frac{\partial q_i}{\partial p_i}\frac{\partial q_j}{\partial p_j} - \left(\frac{\partial q_i}{\partial p_j}\right)^2 > 0. \tag{9}$$

and which may thus be derived without reference to a utility function, since an arbitrary pair of demand functions may for this purpose be treated as linear. Conversely, if (9) is satisfied, values of h can be found which satisfy the preceding inequalities, and so escape Working's objection.

The foregoing results have been deduced on the assumption of free competition among buyers. If we assume free competition among sellers, we shall come to analogous conclusions regarding supply functions. At prices $p_1, \ldots, p_n$ the amounts which will be put on the market may be written

$$q_i = G_i(p_1, \ldots, p_n) \qquad (i = 1, 2, \ldots, n). \tag{10}$$

Solving these equations,

$$p_i = g_i(q_1, \ldots, q_n). \tag{11}$$

Let $v(q_1, \ldots, q_n)$ be the cost of production of a seller who produces quantities $q_1, \ldots, q_n$. He will try to maximize his profit, which is

$$p_1q_1 + p_2q_2 + \cdots + p_nq_n - v. \tag{12}$$

Because free competition exists, he will regard the prices as fixed. Consequently,

$$\frac{\partial v}{\partial q_i} = p_i ,$$

so that the integrability conditions (4) hold also for the supply functions (11). Consequently, the integrability conditions (7) hold for the supply functions (10).

A true maximum of (12) will be assured if the quadratic form analogous to (5), with the second derivatives of v replacing those of u, is *positive* definite. This is equivalent to the inequalities

$$\frac{\partial p_i}{\partial q_i} > 0 , \qquad \frac{\partial (p_i, p_j)}{\partial (q_i, q_j)} > 0 , \qquad \frac{\partial (p_i, p_j, p_k)}{\partial (q_i, q_j, q_k)} > 0 , \ldots , \quad (13)$$

which must be satisfied by the supply functions. The first of these is the familiar proposition that a supply curve slopes upward; the rest are believed to be new. It is obvious that "free competition," in the sense in which we have used the term, excludes both supply curves which slope downward and demand curves which slope upward in the neighborhood of the solution.

In the same way that (8) follows from (6), it follows from (13) that the quantities analogous to those of (8), but calculated from the supply instead of from the demand functions, will all be positive.

These results hold not only for each seller but for the aggregate of sellers, analogously to the case of demand. It also follows that there is a price potential, a function whose derivatives with respect to the prices are the quantities which will be supplied. For two commodities, this sellers' price potential and the cost function may be represented by surfaces which will be concave *upward*.

The equilibrium condition under free competition will be represented by a solution of the simultaneous equations (1) and (10). For two commodities this may be represented graphically by drawing over the plane of q_1 and q_2 the utility surface, which is concave downward, and the cost surface, which is concave up-

ward. The equilibrium q's are the co-ordinates of a point through which a vertical line cuts the two surfaces in points the tangent planes at which are parallel. A similar graphic interpretation may be made by means of the two price potentials.

6. SUGGESTIONS FOR STATISTICAL STUDIES OF DEMAND AND SUPPLY

The statistical determination of demand and supply functions has hitherto been undertaken for single commodities and has encountered in most cases wide fluctuations which lead to great uncertainty. A more hopeful approach may perhaps involve the simultaneous study of groups of related commodities. In such statistical studies, the integrability conditions (4) and (7) should receive careful consideration. In fitting a linear demand function, for example, to the prices and consumptions of n commodities, there are n^2 coefficients to be determined, in addition to the n means. However, the use of the integrability conditions reduces the number of independent coefficients from n^2 to $n(n+1)/2$, with a corresponding gain in the accuracy of the determination by the reduction in the number of degrees of freedom absorbed by these constants. Or the n^2 coefficients might be determined as independent quantities statistically, and then the differences of those symmetrically placed might be compared with their standard errors. In this way a test of the validity of the integrability conditions as applied to the commodities in question could be made. The difference of two symmetrically placed coefficients could be taken as a measure of the degree of inconsistency in buyers' judgments, or of the rigidity of an absolute limit on their money expenditures which cannot be increased with the help of the efficiency to be gained by increased purchases.

When such statistical studies have progressed far enough to consider deviations from linearity, it will be interesting to see whether functions occur which generalize the integrated normal distribution of Section 4. For such functions,

$$log\left(\pm\frac{\partial q_i}{\partial p_j}\right)=-\sum_k\sum_l a_{ijkl}p_kp_l+2\sum_k b_{ijk}p_k+c_{ij},$$

the ambiguous sign being + for supply and − (minus) for demand functions when $i=j$. When $i\neq j$, the sign will depend upon whether the commodities compete with or complement each other.

Measures of "partial elasticity of demand" generalizing Marshall's definition of elasticity have been proposed by Professor Henry L. Moore,[9] who has applied to them a notation suggested by Yule's notation for partial correlation. The range of possible values of these coefficients is infinite. I venture to suggest another measure of correlation of demand which may sometimes prove useful, namely,

$$c_{ij}=\frac{\dfrac{\partial q_i}{\partial p_j}}{\sqrt{\dfrac{\partial q_i}{\partial p_i}\dfrac{\partial q_j}{\partial p_j}}}. \tag{14}$$

If c_{ij} is positive, the commodities compete with each other; if it is negative, they are complementary.

The integrability condition (7) gives $c_{ij}=c_{ji}$. Also, $c_{ii}=-1$. From (9) it follows that the value of c_{ij} lies between -1 and 1. Also, c_{ij} is independent of the units of measure and of money. The resemblance of c_{ij} to the familiar statistical correlation coefficient thus suggested is another of those subtle analogies of economics with the theory of probability to which Edgeworth was so fond of alluding. The analogy might be pushed farther by considering functions of the c_{ij} similar to partial and multiple correlation coefficients.

For a system of only two commodities, let us denote by J the Jacobian of the q's with respect to the p's. Then,

$$\frac{\partial q_1}{\partial p_1}=J\frac{\partial p_2}{\partial q_2},\qquad \frac{\partial q_1}{\partial p_2}=-J\frac{\partial p_2}{\partial q_1},\qquad \frac{\partial q_2}{\partial p_2}=J\frac{\partial p_1}{\partial q_1}. \tag{15}$$

Hence, for this case,

$$c_{12}=\frac{-\dfrac{\partial p_2}{\partial q_1}}{\sqrt{\dfrac{\partial p_1}{\partial q_1}\dfrac{\partial p_2}{\partial q_2}}}, \tag{16}$$

[9] *Quarterly Journal of Economics*, XL (1926), 393.

illustrating again the duality of price with quantity. However, the corresponding expression for systems with more than two commodities is more complex.

Either (14) or (16) may equally be applied to measure correlation of supply, or extent of joint cost, the derivatives being computed in this case from the supply or cost functions instead of the demand functions. If the commodities i and j are produced jointly, like ham and bacon, the correlation c_{ij} of cost will be positive. It will be negative if they compete for productive facilities, as wheat and rye compete for the use of fields and farm labor. But the cost correlation c_{ii} is $+1$.

7. TAXATION UNDER FREE COMPETITION

Let $h_i(q_1, \ldots, q_n)$ be the excess of demand price over marginal cost for a fixed set of q's. Then in the notation of (2) and (11),

$$h_i = f_i - g_i .$$

We shall denote differentiation with respect to q_j by an added subscript j, so that

$$h_{ij} = \frac{\partial h_i}{\partial q_j} = \frac{\partial h_j}{\partial q_i},$$

the last equality being a consequence of the integrability conditions (4), which are applicable to both the supply and demand functions. Let

$$D = \frac{\partial(h_1, \ldots, h_n)}{\partial(q_1, \ldots, q_n)} = \begin{vmatrix} h_{11} & h_{12} & \ldots & h_{1n} \\ \ldots & \ldots & \ldots & \ldots \\ \ldots & \ldots & \ldots & \ldots \\ h_{n1} & h_{n2} & \ldots & h_{nn} \end{vmatrix} . \tag{17}$$

Let p_i and q_i be the equilibrium values, for which supply and demand are equal. Then

$$h_i(q_1, \ldots, q_n) = 0 . \qquad (i = 1, 2, \ldots, n) .$$

Now let a tax t_i per unit sold of the ith commodity be levied upon the producers, and let $p_i + \delta p_i$ and $q_i + \delta q_i$ be the new prices and

quantities. (Here i is supposed to take all the values 1, 2, ... , n.) The demand price must now exceed by t_i the supply price; hence,

$$h_i(q_1+\delta q_1, \ldots . , q_n+\delta q_n)=t_i .$$

Expanding, and subtracting the previous equation, we have to a first approximation appropriate to small taxes,

$$\sum_j h_{ij}\delta q_j=t_i . \tag{18}$$

Solving these equations, we find

$$\delta q_j=\frac{1}{D}\begin{vmatrix} h_{11} \ldots . t_1 \ldots . h_{1n} \\ h_{21} \ldots . t_2 \ldots . h_{2n} \\ \ldots\ldots\ldots\ldots\ldots \\ h_{n1} \ldots . t_n \ldots . h_{nn} \end{vmatrix}, \tag{19}$$

the determinant being formed from D by replacing the jth column by the tax-rates.

The price changes to buyers resulting from the taxes are:

$$\delta p_i=\sum_j f_{ij}\ \delta q_j=-\frac{1}{D}\begin{vmatrix} 0\, f_{i1} \ldots . f_{in} \\ t_1\ h_{11} \ldots . h_{1n} \\ t_2\ h_{21} \ldots . h_{2n} \\ \ldots\ldots\ldots \\ t_n\ h_{n1} \ldots . h_{nn} \end{vmatrix}, \tag{20}$$

where $f_{ij}=\partial f_i/\partial q_j$.

In Section 5 it was shown that the derivatives f_{ij} are the coefficients in a negative definite quadratic form and that the g_{ij} are the coefficients in a positive definite quadratic form. Hence the h_{ij} are the coefficients in the difference of these two forms, which is negative definite. It follows that D has the sign of $(-1)^n$.

For a single commodity, $D(=h_{11})$ and f_{11} are negative; hence, (20) gives a proof that the change of price following the imposition of the tax is positive, the familiar result for this case. However, when more than one commodity is involved, this does not hold.

Let us consider two commodities which compete both in pro-

duction and in consumption, and call the first wheat and the second rye. Suppose that the demand functions are:

$$\left.\begin{aligned} p_1 &= f_1(q_1, q_2) = 41 - 5q_1 - 7q_2 \\ p_2 &= f_2(q_1, q_2) = 58 - 7q_1 - 10q_2 . \end{aligned}\right\} \qquad (21)$$

The plausibility of these functions will perhaps be more evident if we solve for the q's, obtaining:

$$\begin{aligned} q_1 &= 4 - 10p_1 + 7p_2 \\ q_2 &= 3 + 7p_1 - 5p_2 . \end{aligned}$$

If in the foregoing equations both quantities be expressed in millions of bushels, and if there is some measurable attribute, such as number of calories, of which a million bushels of wheat possesses 1 and a million bushels of rye possesses 1.4, then the numbers of these caloric units bought in the two forms at given prices per bushel are:

$$\begin{aligned} q_1' &= 4 - 10p_1 + 7p_2 \\ q_2' &= 4.2 + 9.8p_1 - 7p_2 . \end{aligned}$$

Now, if the price per bushel of wheat increases by unity, that of rye remaining constant, consumers will decrease their consumption of wheat by ten million bushels, that is, by 10 caloric units. Of these, 9.8 caloric units will be made up by increased purchases of rye, while the remaining 0.2 will be dispensed with or obtained from other commodities. Likewise, a unit increase in the price per bushel of rye will mean that 7 fewer caloric units will be derived from rye but will be replaced in the increased consumption of wheat. (These numerical values are, of course, hypothetical, and not of statistical or chemical origin.)

Using millions of bushels, let us assume as supply functions:

$$\left.\begin{aligned} p_1 &= g_1(q_1, q_2) = 13 + 2q_1 + q_2 \\ p_2 &= g_2(q_1, q_2) = 20 + q_1 + q_2 . \end{aligned}\right\} \qquad (22)$$

Now let taxes t_1 and t_2 per unit quantity produced be imposed upon producers of wheat and of rye, respectively. In view of re-

cent proposals, these taxes might be called "equalization fees." From (20) we find

$$\delta p_1 = \frac{-t_1 + 9t_2}{13}, \qquad \delta p_2 = \frac{-3t_1 + 14t_2}{13}.$$

Putting $t_2 = 0$, these results mean that, if rye is untaxed, a tax of 13 cents a bushel on wheat, if not sufficient to stop wheat production entirely, will enable buyers to get wheat at 1 cent a bushel less, and rye at 3 cents a bushel less, than before. On the other hand, a tax on rye benefits producers of both commodities by raising prices, the price of rye being increased by more than the tax.

Thus the conclusion which Edgeworth reached for monopoly is extended to free competition: a tax on sellers may result in lower prices to buyers, not only of the articles taxed, but of others as well.

The simplicity of the foregoing example makes it possible to examine the effect of increasing the tax. The fact that the buyers' prices (21) must exceed the seller's prices (22) by t_1 and t_2, respectively, yields a pair of linear equations whose solution is

$$q_1 = \frac{4 - 11t_1 + 8t_2}{13}, \qquad q_2 = \frac{42 + 8t_1 - 7t_2}{13}. \tag{23}$$

With (22) these values give as the net prices to the sellers remaining after payment of the tax,

$$p_1 = \frac{219 - 14t_1 + 9t_2}{13}, \qquad p_2 = \frac{306 - 3t_1 + t_2}{13}. \tag{24}$$

Since all these p's and q's must be positive, we have four linear inequalities on t_1 and t_2. If $t_2 = 0$, these give one lower and three upper bounds for t_1. Of the latter, the only one which is effective is the least, namely, $4/11$; this may be compared with the price of wheat in the absence of a tax, $219/13$. The significance of the lower bound, $-21/4$, is that a bounty on wheat will increase the production of wheat in accordance with the formulas so long as it is less than $21/4$; beyond this value the equations will not hold

because there is no more rye land which can be transferred to wheat production. But even before these limits are reached, the considerations of Section 4 suggest that the assumed linearity of the functions will cease to be tenable.

We shall now deduce the conditions which must be satisfied for a pair of commodities in order that a tax at rate t on the first may result in lowering both prices under free competition. Since $n=2$, D is positive. Hence, upon putting $t_1=t$, $t_2=0$ in (20), the conditions $\delta p_i<0$ $(i=1, 2)$ become, for $t>0$,

$$f_{11}g_{22}-f_{12}g_{12}>f_{11}f_{22}-f_{12}^2 \tag{25}$$

$$f_{12}g_{22}-f_{22}g_{12}>0\,. \tag{26}$$

Consider the possibility that f_{12} is positive; that is, that the two articles complement each other in consumption. Multiply (26) by f_{12} and (25) by $-f_{22}$, which is necessarily positive, and add. The result, which may be written

$$(f_{12}^2-f_{11}f_{22})(g_{22}-f_{22})>0\,,$$

is absurd, since the first factor is, by (9), negative, and the second is essentially positive. In case $f_{12}=0$, the left member of (25) is negative, while the right member is always positive. We conclude that the lowering of the two prices by reason of the tax requires that the commodities compete in consumption. It also requires that they compete in production; for, since we have just seen that f_{12} must be negative, (26) shows that g_{12} is positive.

Let arbitrary negative values be given the f_{ij}'s, subject only to the universal condition that the right member of (25), shall be positive. Also, let an arbitrary positive value be given g_{22}. The inequalities (25) and (26) then merely impose lower bounds on g_{12}. Taking g_{12} great enough to surpass these limits, we may choose for g_{11} a positive value sufficiently great to satisfy the one remaining condition on these quantities, namely, the second of the inequalities (13), which in the notation of the present section becomes

$$g_{11}g_{22}-g_{12}^2>0\,.$$

In this way the first derivatives of the demand and supply functions are selected, without reduction in the number of degrees of freedom in such a way that the tax causes reductions in the prices. The functions themselves may be chosen without further restrictions, except that they must be positive. This verifies for free competition that the phenomenon is not merely possible but, so far as purely logical (not objective) probability goes, is no less probable than the more familiar contrary case.

For a single commodity, uncorrelated with any other, it is well known that an excise tax reduces the total of producers' and consumers' surpluses by more than the revenue received by the state. The total loss of benefit from the commodity which results from the tax is, apart from higher powers, proportional to the square of the tax. We shall now consider how this situation generalizes to a group of commodities.

By the total benefit we mean

$$w = u - v ,$$

where u and v have the same meanings as in Section 5 (where they were taken as sums for all persons in the market), from which it follows that

$$\frac{\partial w}{\partial q_i} = h_i . \tag{27}$$

Denoting the values which quantities take in the absence of taxation by inclosing them in parentheses, we have for the total benefit when taxes $t_1, \ldots, t_n$ are levied on the several commodities,

$$w = (w) + \sum \left(\frac{\partial w}{\partial t_i}\right) t_i + \frac{1}{2} \sum \sum \left(\frac{\partial^2 w}{\partial t_i \, \partial t_j}\right) t_i t_j + \cdots . \tag{28}$$

Now

$$\frac{\partial w}{\partial t_i} = \sum_k \frac{\partial w}{\partial q_k} \frac{\partial q_k}{\partial t_i} = \sum h_k \frac{\partial q_k}{\partial t_i} ,$$

by (27). But since, as in the equation following (17), $h_k=0$ at equilibrium, all the terms of first degree in the tax-rates vanish, as in the case of a single commodity. Differentiating again,

$$\frac{\partial^2 w}{\partial t_i\,\partial t_j}=\sum_k\sum_l h_{kl}\frac{\partial q_k}{\partial t_i}\frac{\partial q_l}{\partial t_j}+\sum_k h_k\frac{\partial^2 q_k}{\partial t_i\,\partial t_j}\,, \tag{29}$$

the last term dropping out at equilibrium. If we put

$$\left(\frac{\partial q_k}{\partial t_i}\right)=H_{ki}\,,$$

it is evident from (19) that H_{ki} is the cofactor of h_{ki} in D, divided by D. Consequently

$$\sum_k h_{kl}H_{ki}=\delta_{li}\,,$$

where δ_{li} is the Kronecker delta, equal to unity if $l=i$, and otherwise equal to zero. Hence from (29),

$$\left(\frac{\partial^2 w}{\partial t_i\,\partial t_j}\right)=\sum_l \delta_{li}H_{lj}=H_{ij}\,.$$

Thus from (28) we obtain, neglecting powers and products of the t's of degrees higher than the second,

$$\delta w=w-(w)=\tfrac{1}{2}\sum\sum H_{ij}t_it_j\,. \tag{30}$$

This is the change in total benefit; it may also be written

$$\delta w=-\frac{1}{2D}\begin{vmatrix} 0 & t_1 & t_2 & \cdots & t_n\\ t_1 & h_{11} & h_{12} & \cdots & h_{1n}\\ t_2 & h_{21} & h_{22} & \cdots & h_{2n}\\ \cdots & \cdots & \cdots & \cdots & \cdots\\ t_n & h_{n1} & h_{n2} & \cdots & h_{nn}\end{vmatrix}\,.$$

The theorems on adjoint determinants show that, since the h_{ij} are the coefficients of a negative definite quadratic form, the same is true of the H_{ij}. Hence δw is negative; for every set of tax rates there is a loss of total benefit, as measured by the sum of pro-

ducers' and consumers' surpluses and the state revenue. It follows *a fortiori* that the sum of producers' and consumers' surpluses will be reduced by the taxes—a conclusion not entirely obvious otherwise.

The conclusion that the total benefit will necessarily be diminished by the taxes requires the qualification that we have taken no account of what the government does with the money. If the taxes collected from the kind of commodities we have been considering, produced with increasing cost, are used to subsidize industries operating with decreasing cost, with proper regulation to insure that the subsidy will result in sufficiently lower prices to consumers, there may well be a net gain in benefit. For example, it might be an economic thing to levy an excise tax upon agricultural products in order to bring about lower railway rates by a subsidy. However, we can show that it will not pay to tax some increasing-cost industries to subsidize others. For the negative definite quadratic form in (30) is *ipso facto* negative, whether the t's are positive or negative or some are of each sign; the subsidies are represented simply by negative t's.

If a certain revenue $\Sigma q_i t_i$ is to be raised by excise taxes, it is desirable to adjust the rates so that the net loss (30) will be a minimum. The solution of this problem is given by

$$\sum_j H_{ij} t_j = \lambda q_i ,$$

λ being a constant. Solving these equations,

$$t_j = \lambda \sum h_{ij} q_i .$$

The value of λ is determined by the revenue desired, which is the value obtained by multiplying the last equations by q_j and summing for all the values of j.

If one and only one of the commodities (for example, land) has a supply or a demand independent of its price, the corresponding h_{ii} will be infinite. This occurs in only one of the equations of the last set. Consequently the whole revenue should, if possible, be derived by taxing this one commodity.

It has been shown by various writers that a tariff can be justified from a strictly nationalistic point of view if judiciously levied, provided account is taken of the public revenue obtained. The results of this section show that from the standpoint of this same narrow nationalism the justification can in some possible cases be found without supposing that the revenue exceeds the cost of collecting it, for we have seen that the (foreign) sellers may lower their prices to buyers, in addition to paying the tax. In this proof it has not been necessary to make the usual appeal for diminishing-cost industries or to assume a foreign monopoly.

On the other hand, a tariff, like our hypothetical tax on rye, may result in foreign sellers actually receiving more for their products. In either case, a net damage results from the imposition of the duty when the whole human race is considered.

Free competition, with a single price for each commodity, has been assumed up to this point. It is possible to have as many prices for a commodity as there are sellers, and the number of sellers may be small.[19] It is easy to see that in this case also it is possible that a tax on one of two related articles may cause both prices to be lowered, though the sellers pay the tax. Indeed, cases of this limited competition, or duopoly, can be imagined in which the sellers are so separated geographically, or so different in some other respect, that there is arbitrarily little of the competitive element. In other words, cases of competition may exist which are as much as one pleases like monopoly; and for monopoly the phenomenon can occur, as Edgeworth showed, and as we shall now see in more detail.

8. CONDITIONS FOR EDGEWORTH'S PHENOMENON WITH MONOPOLY

The cost function plays a much less essential part in producing Edgeworth's phenomenon under conditions of monopoly than in free competition. It is no longer necessary to assume that the commodities compete in production in order to find demand functions which will lead to a lowering of price by taxation. In what follows, the costs may be positively or negatively correlated or

[19] Cf. my "Stability in Competition," *Economic Journal*, XLI (1929), 41.

independent, or they may be zero; diminishing costs may obtain; but the results deduced will, in their general nature, be unaffected. As soon as a cost function is known, it will be possible to find demand functions displaying Edgeworth's phenomenon.

The monopoly profit will be a function of the prices and of the quantities sold; but on account of the demand relations (1) and (2), it may be expressed in terms of the prices alone or of the quantities alone. Merely for the sake of parallelism with our work for free competition, let us regard the quantities as the independent variables, as Edgeworth did. We shall indicate by added subscripts differentiation with respect to the q's having these subscripts. Denoting the monopoly profit in the absence of a tax by π, the first-order conditions that it be a maximum are thus $\pi_i = 0$. The second-order conditions are

$$\pi_{ii} < 0\,, \qquad \pi_{ii}\pi_{jj} - \pi_{ij}^2 > 0, \ldots\ldots; \tag{31}$$

these are necessary and sufficient that the π_{ij} be the coefficients in a negative definite quadratic form.

If a tax at rate t is imposed upon the first commodity only, to be paid by the seller, the function to be made a maximum is $\pi - tq_1$. The first-order conditions are now

$$\pi_1 = t\,, \quad \pi_2 = \pi_3 = \pi_4 = \cdots\cdots = 0\,. \tag{32}$$

Denoting derivatives with respect to t by a prime, we have from (32),

$$\sum_j \pi_{ij} q_j' = \delta_{i1}\,, \tag{33}$$

the Kronecker delta on the right having the value unity when $i = 1$, and being otherwise equal to zero. These equations may be solved for the q_j'. Let

$$\sigma_{ij} = \frac{\text{Cofactor of } \pi_{ij} \text{ in the determinant } |\pi_{ij}|}{\text{Determinant } |\pi_{ij}|}\,.$$

We may express this relation by saying that σ_{ij} is the conjugate of π_{ij}. It may then be proved that π_{ij} is the conjugate of σ_{ij}. More-

over, the σ_{ij} will satisfy conditions analogous to (31), and so will be the coefficients of a negative definite form.

The solution of (33) may now be written

$$q_j' = \sigma_{1j} . \tag{34}$$

The price changes resulting from the tax will be at the rates

$$p_i' = \sum_j p_{ij} q_j' = \sum_j p_{ij} \sigma_{1j} , \tag{35}$$

with an approximation which is adequate if t is sufficiently small. We are interested in the conditions under which all the quantities (35) are negative.

For the case of two commodities, to which we shall devote the remainder of this section, (35) shows that the tax will diminish the prices if

$$p_1' = p_{11}\sigma_{11} + p_{12}\sigma_{12} < 0 , \tag{36}$$

$$p_2' = p_{12}\sigma_{11} + p_{22}\sigma_{12} < 0 . \tag{37}$$

Since each of the factors in the first term of (36) is negative, we cannot have $p_{12} = 0$. Moreover, p_{12} cannot be positive. For if we suppose that it is, we may multiply (37) by it, and (36) by $-p_{22}$, and add; the result of this would be

$$(p_{12}^2 - p_{11}p_{22})\sigma_{11} < 0 ,$$

which is absurd, because both factors on the left must be negative. Also, since p_{11}, σ_{11} and p_{12} are negative, it follows from (36) that $\sigma_{12} > 0$.

Thus with monopoly, as with free competition, it is necessary that the two commodities compete for buyers if Edgeworth's phenomenon is to take place. This is expressed by the condition $p_{12} < 0$. In neither case is joint cost sufficient to produce the phenomenon in the absence of substitutability in consumption.

Subject to this one condition, and to the conditions of Section 5 on demand functions in general, we can assign arbitrary values to the first derivatives p_{ij} of the demand functions, and also any

cost function, and then determine the second derivatives of the demand functions in such a way that Edgeworth's phenomenon will occur. For, since all the coefficients of σ_{11} and σ_{12} in (36) and (37) are then negative, an arbitrary negative value may be given σ_{11}, and (36) and (37) merely impose two lower limits on σ_{12}. When σ_{12} is chosen greater than both these limits, σ_{22} can be found to satisfy the remaining necessary condition, $\sigma_{11}\sigma_{22}-\sigma_{12}^2>0$. The conjugate quantities π_{ij} may then be calculated, and will satisfy the requisite conditions (31).

The next step in choosing the demand functions involves the cost function v, whose derivatives we shall write g_1 and g_2, as before. Since

$$\pi = p_1q_1+p_2q_2-v\,,$$

we have

$$\left.\begin{aligned}\pi_1 &= p_1+p_{11}q_1+p_{12}q_2-g_1\\ \pi_2 &= p_2+p_{12}q_1+p_{22}q_2-g_2\end{aligned}\right\}. \tag{38}$$

Differentiating again,

$$\left.\begin{aligned}\pi_{11} &= 2p_{11}+p_{111}q_1+p_{112}q_2-g_{11}\\ \pi_{12} &= 2p_{12}+p_{112}q_1+p_{122}q_2-g_{12}\\ \pi_{22} &= 2p_{22}+p_{122}q_1+p_{222}q_2-g_{22}\end{aligned}\right\}. \tag{39}$$

Any positive values may now be given q_1 and q_2. Everything appearing in (39) has now been chosen excepting the four second derivatives p_{111}, p_{112}, p_{122}, and p_{222}, which incidentally are the third derivatives of the utility. In (39) we have three linear equations in these four quantities. Their consistency is evident, since p_{111} may be given a completely arbitrary value, and the rest are then determined in turn. The values, corresponding to maximum profit, of the first and second derivatives of the p's having now been chosen, nothing remains but to choose the constant terms in the expansion about the maximizing values, terms which need only to be positive, and the terms of orders higher than the second; these are in no way restricted by the condition that the prices be lowered by the tax.

In this way it is easy to construct demand functions giving the

effect under consideration, the p's being obtained explicitly as functions of the q's. The simplest functions of the q's would be polynomials of the second degree; Edgeworth's second example was of this character, his first being more complicated.

A closely similar procedure to that above yields demand functions which exhibit the phenomenon in the somewhat more desirable form of functions of the prices which give the quantities bought. An example with zero cost is

$$\left.\begin{aligned} q_1 &= 1-2(p_1-1)+(p_2-1)-30(p_1-1)^2+7(p_1-1)(p_2-1) \\ q_2 &= 1+(p_1-1)-2(p_2-1)+\tfrac{7}{2}(p_1-1)^2 \end{aligned}\right\}. \qquad (40)$$

Unit quantities are sold at unit prices to yield a maximum monopoly profit in the absence of a tax, if there is no cost of production. For a sufficiently small tax on the first commodity, both prices decrease. To verify this, we note that the monopoly profit is

$$\pi = p_1q_1+p_2q_2-tq_1 . \qquad (41)$$

Denoting temporarily differentiation with respect to p_1 and p_2 by subscripts, we have as the conditions for a maximum,

$$\pi_1 = 0 , \qquad \pi_2 = 0 .$$

These equations hold for every value of t. We may therefore differentiate them with respect to t. This gives:

$$\begin{aligned} \pi_1' &= \pi_{11}p_1'+\pi_{12}p_2'-q_{11} = 0 \\ \pi_2' &= \pi_{12}p_1'+\pi_{22}p_2'-q_{12} = 0 . \end{aligned}$$

Differentiating (40) and (41), then putting $p_1 = p_2 = 1$, $t = 0$, and substituting for the π_{ij} and q_{ij}, enables us to solve the last two equations, obtaining

$$p_1' = -1\tfrac{1}{17} , \qquad p_2' = -1\tfrac{9}{17} .$$

In competition the reduction of price through taxation could be displayed by linear demand and cost functions. This is not

true for monopoly. For in this case all the g_{ij} and p_{ijk} would vanish, and (39) would reduce to $p_{ij}=\frac{1}{2}\pi_{ij}$. When this is substituted in (35), an elementary property of determinants applied in connection with the definition of σ_{ij} gives $p_i'=\frac{1}{2}\delta_{ii}$. Hence p_i' cannot be negative. Thus, the second derivatives of the demand and cost functions play an essential part.

Consider now such a case as that of two stores in the same city, identical in all respects, symmetrically placed with regard to customers, and selling just one commodity. Suppose them controlled by a single owner. Will a tax levied upon the quantity sold in one of the stores cause him to raise or to lower his prices?

This is essentially the case we have been discussing of a monopolist selling two articles. The demand will be correlated, since an increase in price at one of the stores will send some customers to the other, and we shall have $p_{12}<0$. Even if there are other competing stores selling the same commodity, the case is essentially little different. The feature whose consequences we will now examine is the *symmetry*.

The demand functions will, on account of the symmetry with respect to the market, be such that $f_1(q_1, q_2)=f_2(q_2, q_1)$, while the cost functions will, on account of the identical nature of the two stores, have the property that $g_1(q_1, q_2)=g_2(q_2, q_1)$. For any such symmetry it must be that $\pi_{11}=\pi_{22}$, and consequently $\sigma_{11}=\sigma_{22}$; also $p_{22}=p_{11}$. The relation $\sigma_{11}\sigma_{22}-\sigma_{12}^2>0$ gives, in this case,

$$\sigma_{11}^2-\sigma_{12}^2>0\,.$$

From (36) and (37) we deduced that $\sigma_{12}>0$ if Edgeworth's phenomenon occurs. If we assume this, we may multiply (37) by σ_{12} and (36) by $-\sigma_{11}$, which is always positive, and add. Putting $p_{22}=p_{11}$, this gives:

$$-p_{11}(\sigma_{11}^2-\sigma_{12}^2)<0\,.$$

Since $p_{11}<0$, this is an absurdity. Hence Edgeworth's phenomenon cannot arise in a perfectly symmetrical situation.

But even with symmetry it is possible that the price at the untaxed store may be lowered as a result of the tax, though the

price at the taxed store is increased. It is easy to construct such cases; for instance, with zero costs,

$$q_1 = a - 2(p_1 - c) + (p_2 - d) + \tfrac{1}{4}(p_1 - c)^2 - \tfrac{1}{2}(p_1 - c)(p_2 - d) - \tfrac{1}{4}(p_2 - d)^2$$
$$q_2 = b + (p_1 - c) - 2(p_2 - d) - \tfrac{1}{4}(p_1 - c)^2 - \tfrac{1}{2}(p_1 - c)(p_2 - d) + \tfrac{1}{4}(p_2 - d)^2.$$

Here a, b, c, d may be any positive quantities satisfying

$$a = 2c - d\,, \qquad b = -c + 2d\,.$$

9. THREE OR MORE COMMODITIES

That the prices of three or more commodities may be lowered as a result of a tax imposed upon one of them follows from the fact that this is possible for two commodities, because a continuous array of degrees of similarity can be conceived, in such a way that several commodities merge gradually into one. The discussion in the last section is largely applicable to any number of commodities. However a few new features enter.

For n commodities, the equations analogous to (39) are $n(n+1)/2$ in number. The number of independent unknowns p_{ijk}, the order of the subscripts being immaterial, is

$$\frac{n(n+1)(n+2)}{6}\,,$$

and is thus considerably in excess of the number of equations. That these equations are actually consistent will appear when the matrix is shown to contain a non-vanishing determinant of order $n(n+1)/2$. If we arrange equations and unknowns in the order of the first index and then in the order of the second, such a determinant will stand at the left of the matrix. Its principal diagonal will consist entirely of 1's, with zeros below.

The analysis of the last section might have been carried out with the prices instead of the quantities as the independent variables. This involves introducing quantities ρ_{ij} conjugate to $\partial^2\pi/\partial p_i \partial p_j$. The ρ_{ij} are the coefficients in a negative definite quadratic form. In terms of these quantities,

$$p_i' = \sum_j \rho_{ij} q_{ij}\,.$$

From this a proposition of some interest follows: *If all the prices are lowered by a tax, the taxed commodity must compete with at least one of the others.* If this were not true, all the derivatives q_{11}, $q_{12}, \ldots, q_{1n}$, would be negative or zero. Since each p_i' is to be negative, we should then have

$$\sum p_i' q_{1i} = \sum\sum \rho_{ij} q_{1i} q_{1j} > 0 .$$

But the second member of this equation is a quadratic form which must be negative definite, so that there is a contradiction.

Articles sold by the monopolist which complement that taxed, or which, so far as first-order terms in the expansion go, are neither complementary nor competitive with it, may also decrease in price as a result of the tax, provided the monopolist sells at least three different commodities. Examples may easily be constructed to show this.

10. SUMMARY

Edgeworth's examples proving that a monopolist may find his most profitable course in lowering the prices of two articles which he sells as a result of a tax which he must pay on one of them we have simplified, at the same time setting forth the conditions upon which the phenomenon depends. These conditions include asymmetry of cost or of demand for the two commodities, as well as the analytical conditions of Section 8. In Section 2 a simple example with discontinuous demand is given to illustrate the phenomenon.

Though Edgeworth attributed the phenomenon to conditions of monopoly, it has been shown in Section 7 that a tax on sellers of two commodities may result in both prices being lowered even under free competition. Necessary, though not sufficient, conditions for this are that the commodities compete both in consumption and in production. Many agricultural products satisfy these conditions.

In monopoly it is necessary that the commodities "compete" for customers, in the sense that each may, to some extent, replace the other. If a monopolist sells three or more commodities whose prices will be lowered when a tax is imposed upon one of them, the

taxed commodity must be a possible or partial substitute for at least one of the others, but not necessarily for all.

Edgeworth's phenomenon has generally been considered very improbable in the actual economic world. The basis for this belief seems to be that demand functions constructed at random usually do not display it, together with an elementary proof that for a commodity unrelated to any other a tax leads to an increase in price. But this simplified case is not realized in the complex economic system which exists; and the construction of hypothetical systems at random depends upon irrelevant features of the convenience and mathematical equipment of the student rather than upon objective truth. The algorisms given in Sections 7 and 8 for the construction of examples make clear that there are as many degrees of freedom in situations displaying the phenomenon as in those which do not, both in competition and in monopoly.

In order to make sure that all the relevant conditions are examined in coming to the conclusion that there is nothing improbable in the phenomenon, a more intensive study is made in this paper than had previously been undertaken of the conditions which demand and supply functions may reasonably be expected to satisfy. This study yields results which have a direct bearing upon statistical studies of demand and supply, and leads to suggestions regarding the direction which these studies may well take. In the study of groups of commodities, considerations enter which are of a different nature from those involved in the study of single commodities.

The theory of probability is used in Section 4 to prove that the demand or the supply function for a single commodity is of the nature of an ogive and that such functions may often be expected to have the form of the integral of the normal probability distribution. This opens up interesting possibilities of using such mathematical theories as that of semi-invariants in a combined attack by statistical and by technological studies upon the urgent and difficult problem of finding definite demand and supply functions.

HAROLD HOTELLING

COLUMBIA UNIVERSITY

THE THEORY OF POPULATION: SOME QUESTIONS OF QUANTITY AND QUALITY

I

OWING largely to Dr. Edwin Cannan's influence the direction of modern economic thought on population is toward a more detailed discussion of the relation between numbers and maximum productivity. In his manual on *Population* Professor Carr Saunders has summarized the optimum theory of population as follows:

> In any country at any given time there is a certain amount of skill and knowledge available and there are certain habits and customs which govern the use made of this skill and knowledge. Taking all these conditions into consideration, then it is clear that there is a particular density of population which must be reached and must not be exceeded if the largest possible income per head is to be obtained. As we have seen there is for any piece of land, when a certain amount of skill is available, a point where, by the application of a definite amount of capital and labour, the maximum return per head is reached; if less is applied the return per head will be less, and if more is applied the return per head will be less, though in this latter case the total produce will be greater. So in any country, however many complications may be introduced by the rise of industrialism and the exchange of manufactured articles for food grown abroad, there is a density of population which is more desirable than any other from the point of view of income per head. This may be called the "optimum" density . . . . a density, that is, which is the most desirable having in view the purely material ideal of the average income of the inhabitants.[1]

There is general agreement that "the optimum point is not absolute; under changing conditions of industrial life it can be pushed considerably forward,"[2] and, on the other hand, it is recognized that adverse changes may diminish, or push back, the optimum. Although, as Professor Cannan has said, "the point as it may be called of maximum productiveness is constantly being shifted by the progress of knowledge and other circumstances" and "the shifting is generally in the direction of increasing the

[1] *Population* (Oxford, 1925), pp. 26–27, 31.

[2] Sir Josiah Stamp in *The Observer*, October 30, 1927.

population which is consistent with the maximum productiveness possible at the time,"[3] this is not invariably so. Increase of population means, on the one hand, increased demand for commodities and services, and, on the other, potential productive power; and this suggests that quantity of population is not everything. Quality is highly important. It is as necessary to ask, What kind of people do we want in our country? as it is to inquire—Have we the right number of people? Moreover, it is important to notice that although *possible* density of population is always greater than the *most desirable* density, and a low standard of life will necessarily accompany the former, a high standard will not always go with the latter. A certain number of persons may be the optimum density of a certain region at a given time and yet have a very low standard of life; but if at that time and in those circumstances the number of people was more or less, the standard would be lower still.

The optimum theory, then, is instrumental in indicating numerous pitfalls, such as the supposition that the point of maximum productivity per head is fixed; or the argument—often fallacious—that unemployment is necessarily a sign of overpopulation. Moreover, although the optimum number cannot be named at any *point in time*, this is not such a serious drawback as at first sight it might seem, for, as Professor Cannan argues, the question of the ideal or optimum population is *primarily one of the rightness of a movement of population over a period of time.*[4] "The taxable capacity of any country," says an authority on public finance, "is not an absolute amount, and one can only suggest symptoms which show that the taxable limit is being approached, or the reverse. Precise limits are not capable of being assigned with accuracy."[5] Now it is as unsound to argue that, because the optimum number of people cannot be determined and stated statistically at any point of time, the whole theory is unserviceable, as it would be to say that the concept of taxable capacity is

[3] *A History of Theories of Production and Distribution* (3d ed.), (London, 1924), p. 397.

[4] Cannan, *Wealth* (3d ed.), London, p. 61.

[5] Shirras, *The Science of Public Finance* (London, 1924), p. 131.

useless because such a limit cannot be set forth as so many pounds sterling. Professor Cannan says:

> [The] best population for any particular moment is that which is compatible with population taking the best possible line of movement, whether that be increase or decrease, slow or rapid. . . . . In considering at any time the desirability in the interest of future mankind of increasing or decreasing population, we have to weigh on the one side the advantages which may be expected from the greater possibilities of gain from co-operation if people are more numerous against the advantages which may be expected from the greater relative plentifulness of land surface, natural forces and materials, and man-made material equipment, if people are less numerous.[6]

II

It will now be very convenient to employ Dr. Dalton's symbols. He says:

> Maladjustment is a function of two variables, actual and optimum numbers. If A represents actual numbers and O the optimum and M the degree of maladjustment, then $M = (A - O) \div O$. Positive values of M indicate overpopulation, negative values underpopulation.[7]

Dr. Dalton also points out that O is not necessarily less variable than A. On the contrary, it is more sensitive to changes in its economic environment, so that A is generally less variable than O.

Let us first consider material resources in relation to variations of O. The discovery of new natural resources such as mineral deposits, which can be worked economically, may be expected to increase the optimum, while the exhaustion of resources will tend to produce the opposite effect. But a decrease of O will not necessarily be permanent in all cases, for the growing scarcity of resources often operates as a stimulus to the improvement of methods of exploiting existing resources or the discovery of new ones. As Professor Cannan has shown, the quantity of natural resources is not the only factor: facilities for internal and external economic co-operation are also highly important partial determinants of the optimum in any country. If we assume that A is increasing, but is less than O, and that natural resources are for the time being constant; then although the increase of A lowers

[6] Cannan, *A Review of Economic Theory* (London, 1929), p. 83.

[7] *Economica*, March, 1928, pp. 35–37.

the quantity of natural resources per head of population, it is quite possible for the facilities for economic co-operation to increase so as to outweigh the natural-resources factor. Even where natural resources are diminishing absolutely, the rate of exhaustion is generally slow, so that a concurrent improvement of co-operation facilities might cause O to increase in spite of the exhaustion of natural resources; or at least prevent a decrease of O. This seems less improbable when we reflect that co-operation facilities are much more completely under human control than natural resources. On the other hand, account must be taken of the aberrations to which human actions are liable. Sudden and serious dislocation of co-operation facilities arising from time to time, out of wars, tariff struggles, and so forth, is always a possibility, and the resultant decrease of O in any given country will be a function of the importance of co-operation facilities, especially external facilities, in its economic life.

New inventions play an important part in the development and use of a country's resources, but it is a matter of the greatest difficulty to formulate even tentative generalizations as to their influence upon the optimum. Some inventions seem to make a larger population desirable, while others make a smaller population desirable. Such inventions as those which make machines automatic—"almost human," and in some respects superhuman, since the machine is less fallible—appear to decrease the optimum. In other words, the most desirable density of a population equipped with automatic machines is less than that of a population in the same country without them, because the aggregate product depends less and less upon the quantity of human labor, and more and more upon the quantity of machines. But, as Professor Robbins has indicated, there is the possibility that a machine which is labor saving in one industry may actually require *in the aggregate* more labor when all connected and affected industries are considered. So that the result of such a change is an increase of the optimum, and the full advantages of a potential advance in industrial or commercial technique may prove unattainable in the absence of a sufficient increase of actual population.

In addition to changes of this kind, important widespread

changes in tastes and fashions might cause variations of the optimum, for a country well placed in every way for supplying a given range of commodities with a given population, O_n, might find that for production of a different range of commodities more people or less than O_n might be the optimum number. Again, variations of O may be caused by changes in the *distribution* of a given national income, as well as by increases or decreases in its size. Dr. Dalton says:

> Changes in the distribution of income in modern communities, resulting in changes in the relative demand for various commodities and services, and also in their relative supply, may change the optimum. . . . . There are some grounds for supposing that a less unequal distribution of income would lower the optimum, partly through increasing the relative demand for food and other commodities produced under conditions where diminishing returns come relatively early.

It follows, of course, that improvements, inventions, and discoveries which counteract this early advent of diminishing returns will also help to counteract the tendency of the optimum to decrease. The substitution, however caused, of a foodstuff or foodstuffs produced under conditions of constant or increasing returns, for others, previously important in the family budgets of the people, but produced under diminishing returns, would tend to prevent the decrease of O which would otherwise be probable.

Deterioration or destruction of capital equipment will certainly tend strongly to reduce the optimum. Professor Carr-Saunders mentions the case of Mesopotamia, where the optimum decreased greatly and rapidly after the all-important irrigation system of the country had been destroyed by invaders. This example suggests several reflections: (1) The decrease of O would not necessarily mean that such a country would be overpopulated after the invasion, for A might have been so much less than O before the invasion that, although O has decreased, it is still greater than A—or the destruction of population and the emigration of refugees during the invasion might have diminished A so much that it is less than O, although O also has decreased. (2) The construction of an irrigation scheme, or its reconstruction after it has been destroyed or allowed to decay, might easily result in an in-

crease of O, because of the additional land thereby made available for cultivation. (3) Where a country's productivity is largely dependent upon a natural resource, such as the flow of water, whoever controls that resource has the power to vary the size of O. This becomes clear if we suppose the owners of the dams on the Upper Nile to be able to divert the flow of the river so as to prevent the periodical floodings of the land in Lower Egypt.

So far we have not considered the *composition* of populations. Suppose two areas, E and F, similar in all respects except that in E the population contains 20 non-workers per 100; and in F only 10 non-workers per 100. It is clear that, unless we confine ourselves to the consideration of workers only, O will not be the same number for E as for F, since every 80 workers in E have to support themselves and 20 non-workers; but in F, 80 workers must support themselves and slightly less than 9 non-workers. Now suppose that in these conditions 80,000 *workers* in E, and the same number of workers in F, are the numbers which can produce the maximum product per head; then the optimum population will be 100,000 persons in E, and rather less than 89,000 in F. Such differences in the proportions of workers and non-workers may be, in the main, the reflection of differences in the age-distributions of the two populations. Also, age-distribution, in its turn, may affect the relative efficiencies of working populations. The Balfour Committee on Industry and Trade estimated that between 1913 and 1924 the "employee" or "occupied" population of Great Britain increased by nearly 900,000; but owing to "the effects of the war on the age-distribution of the population, practically the whole increase in the number of men employees is found in the older age-groups, i.e., among those whose average productive capacity must be below the maximum." The numbers and ratios of "persons of working age" in Great Britain increased between 1861 and 1921 as shown in Table I.

Thus the increased survival rate in the male age-groups between forty-five and sixty-four appears to have been so great that it was more than sufficient to outweigh the abnormal war losses of males in the age-groups between fifteen and forty-five. An examination of the table of "persons gainfully occupied" in Great

Britain given in the *Twentieth Abstract of Labour Statistics*, 1931, (p. 3) yields the results given in Table II.

On the assumption that the average productive capacity of producers in the age-groups above forty-five is, on the whole, less than in the younger age-groups, it seems that, *ceteris paribus*, the amount of produce per head will be likely to decrease. Conversely

TABLE I

Date of Census	Persons Aged 15–64 Years			
	Males		Females	
	000's Omitted	Percentage of Total	000's Omitted	Percentage of Total
1861	6,590	58.8	7,202	60.5
1891	9,509	59.4	10,359	60.7
1921	13,309	65.2	14,937	66.8

TABLE II

Percentage of Males and Females Gainfully Occupied

	1911	1921
Under 15 years of age	5.9	5.0
15 and under 20	13.7	13.7
Between 20 and 44	56.7	53.3
45 and upwards	23.7	28.0
	100.0	100.0

it seems probable that a change in the age-distribution of a population in the direction of giving a higher proportion of workers in the age-groups twenty to forty-four would, *ceteris paribus*, cause an increase of produce per head.[8]

Closely akin to the question of age-distribution is that of the general health of a population. An improvement in general health is likely to result in an increase both in the numbers and efficiency

[8] Cf. Dr. Bowley's calculations in *Economic Journal*, June, 1924, p. 189, which show that even on the hypothesis of constant birth and death rates, and the absence of migration, there is high probability of changes in the age-composition of Britain's population in the next forty years.

of the workers. Assuming no change in age-distribution, there is reason to suppose that such an increase in healthiness, while it increases *A*, would decrease *O*, since a highly healthy population would possess greater efficiency per head and would require fewer persons to tend the sick and to staff the institutions and organizations which high sickness rates necessitate in civilized societies. Or, to put it in another way, the efficiency of a community of 100,000 persons is reduced much more than 10 per cent if 10,000 of its members fall ill. If under the more healthy conditions a smaller population would be optimal, *A* and *O* will be brought closer together if *A* was previously less than *O* (and *M* therefore negative), and *M* (maladjustment) will become smaller. But if *A* was previously greater than *O*, then *M* becomes greater than before and is still positive. An improvement of health, however, might be of such a nature as to result in a considerable change in the age-distribution. It might, for instance, result in a higher proportion of children and aged persons, i.e., of non-workers to workers—a change which would affect the optimum. Probably *O* would not diminish nearly so much as it would in the absence of such a change in the age-distribution, because the proportion of workers in the population is now smaller, and although fewer persons will be required to tend the sick, rather more will be needed to attend to the children's requirements, especially in the matter of education.

Although the birth rates show a general downward trend in a number of European countries (including Great Britain) and in the British Dominions, the death rates in those countries are also falling steadily, so that a considerable (though reduced) natural increase of population is still proceeding, while the age-distributions are also changing because, although in the fight against disease more success is being achieved among the very young than among the very old, the proportion of children is falling. Apparently these facts have already become significant. A recent League of Nations report on the natural movement of populations during the first quarter of the twentieth century states:

> The increase of population must be considered in relation to age-composition, which is being rapidly altered through the falling birth and death

rates. . . . . It may be pointed out that, other factors being equal, countries where a considerable natural increase depends upon a low death rate and not upon a high birth rate are usually better able to absorb this increase themselves than countries with an excess due to a high birth rate.

In addition to changes in age-composition, there is, of course, the possibility of a growing disproportion between the sexes: but it seems unlikely that any disproportion which could conceivably arise in the course of the *natural* growth of a population would be great or rapid enough to outstrip the gradual economic adjustments (e.g., of work as between the sexes) to which such a phenomenon, if long continued, would certainly give rise. Therefore,

TABLE III

EMIGRATION OF BRITISH SUBJECTS FROM THE UNITED KINGDOM TO NON-EUROPEAN COUNTRIES, 1924–30*

	NUMBER OF EMIGRANTS (IN THOUSANDS)		
	1924	1927	1929
Male adults	67.3	70.2	66.5
Female adults	60.3	58.1	55.7
Children under 12	27.8	25.2	21.5
Total	155.4	153.5	143.7

* Figures taken from *Cmd. 3737*, 1930, p. 347.

a priori it does not appear that any appreciable variation of the optimum is likely to arise from this cause, *unless the disproportion is caused by migration.*

It is clear that among a given group of immigrants the distribution by age and sex is an important consideration from the viewpoint of the country of immigration, as well as from that of the country of emigration. For example, should there be a high proportion of children under fifteen, the immediate increase in the amount of work done in the country of immigration will be less than it would have been had the proportion of workers to non-workers in the group been higher, and much less than it would have been had the group consisted entirely of able-bodied males. In general, more males than females migrate. Although among British emigrants the disproportion between the sexes is slight,

for European emigrants as a whole the ratios of males to females have fluctuated during the post-war period between 7:3 and 6:4. In terms of potential *industrial* productive power the preponderance of males is even greater, since many of the females are wives who do not enter any employment. But, for the most part, those not in industry are employed as housewives, and therefore, on a broader view, they may fairly be regarded as workers.

III

Where an increase of population is very largely due to immigration, any consequent variation of the optimum will be caused by the productive efficiency of the newcomers in relation to the original population, the resources to which they can obtain access, and the development possibilities of the country. An increase of A in this way does not necessarily mean an increase of O. But it may do so under certain conditions. For example, suppose an area of dry soil which, in the absence of irrigation, has an optimum population of 500 persons (i.e., $A = 500$, and $O = 500$). Now suppose an influx of 600 immigrants, many of whom are skilled in the construction of irrigation works, and let them set to work upon a scheme. Upon the completion of the works, although A would then be 1,100, O would doubtless be far in excess of A: and *a fortiori* if the majority of the immigrants left the area after the irrigation scheme had been carried through.

There is clearly a significant difference between what one of the Geneva documents calls "emigration proper" and a mere "emigration of labor" or temporary international exchange of labor. A great deal of migration is, in fact, temporary. One thinks immediately of the migrations of agricultural workers at harvest times; and, where these have become regular seasonal occurrences, O varies seasonally and the maintenance of the ideal balance between population and productivity must depend, more or less, upon their continuance.[9] Clearly, a country in which the actual

[9] In 1907 the "total number of migratory labourers, largely Russians, Poles, and Austrians," crossing into Germany was 257,329; "by 1912–13 it amounted to nearly 500,000," and even then the seasonal demand was not entirely satisfied. Knight, Barnes, and Flugel, *Economic History of Europe*, Part II, "Modern Times," Boston, 1928, pp. 471–72.

permanent population is equal to the optimum so long as the usual seasonal migrations occur regularly, will suffer from maladjustment if the migrations diminish considerably or cease entirely. For a country which receives seasonal immigrants the problem may be expressed as follows:

$$M = \frac{A+T-O}{O}$$

when T represents the amount of temporary immigration. Therefore, M will be equal to zero when $A+T=O$. Diminish or eliminate T, and M becomes negative, indicating that the country is underpopulated. At first glance the remedy appears to be an increase of A; but the time element makes the problem more difficult, since an increase of numbers equal to T cannot be employed throughout the whole year. Moreover, the age and sex of a normal increase of population equal to T would in all probability be different from that of a similar number of harvesters, or other seasonal immigrants.

Temporary sojourns of immigrants—usually very largely adult males—in another country "with a view to taking up a remunerative occupation there on a temporary basis" may, of course, last longer than one harvest. They may extend over several years without altering essentially the temporary nature of the stay. There is, for instance, the type of immigrant who "makes a pile" (often not a very large one unless judged by a low standard) and then returns to his native land richer, and perhaps wiser, than when he left it. Fairly constant streams of migrants of this type will probably benefit the native lands, on the whole, by the exchange of the more experienced individuals returning with their savings, for the less experienced individuals "outward bound" with little beyond their capacity to work; unless the productive powers of the returning migrants have been seriously impaired during their absence abroad. At the same time, product per head might be increased in the country of immigration by the influx of people who are, by the nature of the case, extremely anxious to work hard and save hard; but against this must be set the fact that they are to work in more or less strange conditions, and that

the removal of their savings when they depart will tend to reduce the amount of new capital in that country. Some account must also be taken of the facts that (*a*) temporary migrants sometimes become permanent settlers, and (*b*) all temporary sojourners do not succeed. "It seems to be obvious," says a recent League of Nations report, "from the statistics covering the last few years that the European streams of continental migration, which are often considered as temporary migrations of labour, are tending more and more to assume the character of migration which ends in definite settlement in another country."[10] On the second point it is sufficient to remark that every returning group of migrants contains some disappointed failures; but since they are an unknown, and perhaps negligible, quantity, the effects of their return cannot be estimated.

If we take language, climate, and institutions as being likely to present the chief obstacles to the absorption of immigrants as efficient producers, and therefore factors contributing to variations of the optimum, it is obvious that there are a number of intermediate situations, more or less favorable, in which immigrants may be placed—between the most favorable, where language, climate, and institutions are the same as, or substantially similar to, their own; and the least favorable, where all the conditions are completely foreign to them. The stage of economic development of the country of immigration is, of course, another important factor. Here, then, we find an economic argument in favor of careful selection of immigrants. Those who would eliminate maladjustment must take into account not only the *numbers* of the newcomers, but *their quality and fitness to dovetail into the economic system of the community into which they have come.* This observation is reinforced by the fact that quantitative restrictions upon immigration create conditions favorable to the qualitative selection of immigrants.

The effects of migration upon the countries of emigration also claim attention. At best, migrations may increase the optimum in each of the countries affected; at worst it may mean a fall of *O*

[10] *Migration in Its Various Forms*, League of Nations, C.E.I. 25 (Geneva, 1926), p. 5.

in both. Much will depend, as we have already seen, upon the type of migrant. In recent years, for instance, numbers of skilled craftsmen have left the United Kingdom for the United States[11] (see Table IV), and the effect of their departure upon the former is worth consideration.

The question arises—Can a densely populated country dependent largely upon its exports of high-grade manufactures for the maintenance of existing standards of life afford to lose the cream

TABLE IV

OCCUPATIONS OF BRITISH MALE EMIGRANTS FROM THE UNITED KINGDOM DURING THE PERIOD 1924–30*

Occupations	No. of Males Aged 18 Years and Over (In Thousands)	Percentage of Total
Agricultural	88.1	22.6
Commerce, finance, and insurance	63.6	16.3
Professional	20.7	5.3
Skilled trades	121.5	31.1
Transport and communications	15.5	4.0
Laborers not in agriculture or transport	36.3	9.3
Other occupations	45.1	11.4
Total	390.8	100.0

* Nine months of 1930 only.

of its craftsmen? Can any considerable movement of this kind continue without causing a decrease of *O*? If, among the whole population, a given proportion of fully skilled and experienced craftsmen is desirable, are the existing training arrangements capable of filling adequately the gaps caused by emigration? These questions prompt the observation that selection of emigrants may have as much significance for the United Kingdom as selection of immigrants has for the United States, Australia, or Canada. Where the inhabitants of a given country are in excess of the optimum number, it does not follow that *any* reduction of numbers will tend to bring *A* and *O* closer together, and so reduce the magnitude of *M*. Indeed, the contrary effect may be produced. The departure of certain types of workers may reduce

[11] Cf. *Report on Industrial Conditions in Canada and U.S.A.*, Cmd. 2833, 1927, p. 20.

productive efficiency so much that O may fall faster than A, and so cause an increase of M. Among European nations, Germany, Spain, Roumania, Italy, Poland, and Czechoslovakia have imposed various restrictions upon those types of emigration which they think likely to react injuriously upon their economic welfare. Czechoslovakia, for example, prohibits the emigration of agricultural workers except in special cases; Roumania and Spain watch carefully over proposed collective emigrations so as to prevent depopulation of districts or injury to any desirable industry.

Owing to special facilities, the emigration of agriculturists from the British Isles since the war shows a tendency to increase relatively to the whole body of British emigrants. Thus, as Professor Macgregor has pointed out, it seems that in Britain we are trying with one hand to fashion means of preventing rural depopulation, while with the other we hold out to the rural worker inducements to emigrate to the British Dominions. The problem of the redistribution of population within the British Empire does not lend itself, as some people seem to think, to the simple "solution" of transferring fit and willing workers from Great Britain to areas such as Australia. In forming an opinion upon the economic gain or loss of such a policy we must bring into account not only the cost of assisting the emigrants, but the probable effects of the policy upon the optimum points in the countries affected. For example, the loss of skilled agricultural workers and of "selected town-dwellers possessed of energy, enterprise, adaptability, and full bodily strength" may be a price Great Britain can scarcely afford to pay for such relief from overpopulation—if, indeed, overpopulation really exists here—as the departure of emigrants of this type affords.[12] So we come to the tentative conclusion that instead of spending money in sending numbers of *certain types* of workers out of Great Britain, it might pay better to spend something in an attempt to keep them at home.

There is yet another point. A potential increase of the optimum in a country of immigration may not materialize if the bulk of the immigrants do not go to, and remain in, the industries and areas where their labor is likely to add most to the national in-

[12] *Economica*, November, 1923, pp. 217–18.

come. Thus, not only to a born town-dweller, but also to those accustomed to rural life, the lure of the towns, even in a strange country, is often stronger than the attraction of a more healthy life, and, perhaps, higher earnings, in rural districts. Writing of immigration into the United States, M. André Siegfried says: "The newcomers . . . . instead of heading for the great open spaces of the West, ... now congregated in the Atlantic ports or in the industrial and mining centers of the East. . . . ."[13]

If such a deflection is at all considerable, an increase of the optimum may be hindered not only in the country of immigration, but in the country of emigration as well. It is, for instance, generally agreed that the more development there is in the agriculture, and among the agricultural populations of the British Dominions, the better it will be for British industries. So that although the loss of able-bodied persons might not be immediately beneficial to Great Britain, the balance of benefit in the long run, due to their productivity in the Dominions and their demand for British manufactured goods, might justify economically the redistribution of population. But if large numbers of the migrants do not go into, or remain in, agricultural pursuits in the Dominions, maximum beneficial results will not be attained either in Great Britain or the Dominions. The effect upon the former might be such a fall of the optimum as to leave *O* farther from *A* than before. These remarks are made, of course, upon the assumption that a substantial proportion of the manufactured goods consumed in the Dominions continue to be bought from the mother country. But this may not always be the case, since the people of the Dominions are free to buy where they choose and to set up factories of their own. Putting the point in general form, then, we may say that maximum productive efficiency cannot be attained until the right numbers of workers of the right quality are to be found working, or are induced to work, in the right places.

We must recognize that it is not beyond the bounds of possibility that in the long run a loss of skilled workers may produce such reactions in the employers' ranks as will make them anxious

[13] *America Comes of Age* (New York, 1927), p. 7.

to substitute for that type of labor which has become dear and difficult to obtain and retain, more and better capital equipment. This movement might make a smaller population desirable, but whether M will be reduced or not will depend upon the decrease of A relatively to the decrease of O.

Obviously, few countries are masters of their own fate in the matter of migration. In this, as in other departments of economic life, no country can hope to escape entirely the reactions caused by the doings of others. Changes in the immigration laws of one or more of the chief countries of immigration will certainly affect A, and possibly O, in most, if not all, of the chief countries of emigration. Where alternative countries of immigration exist, it is reasonable to expect that restrictions upon immigration in one or more directions will produce appreciable changes in the flow of immigrants to those alternative countries, and in the distribution of immigrants according to nationality. Some variations of the optimum points in the countries of immigration would no doubt result; but to determine theoretically the probable extent and direction of such movements would necessitate the framing of numerous hypotheses and the development of as many intricate arguments for which there is no space here. Let us, however, examine the statistics shown in Table V. Clearly the drastic restriction of migration into such a great immigration region as the United States must lead to the revision of population policies in many other countries, whether they be countries of immigration or emigration. Another factor is the change in the distances and costs involved in reaching whatever alternative countries of immigration there may be.

It may be objected that too much attention is here devoted to migration; but the answer is that the basis of this objection is underestimation of the importance of the relation between migration and economic productivity in the modern world. Immense changes in the distribution of population between various important countries have taken place in the last hundred years, and a leading factor has been the economic attractiveness of such countries as the United States.[14] This attractiveness is clearly a con-

[14] Cf. Cannan, *An Economist's Protest* (London, 1927), pp. 3–4.

tributory cause of variations of the optimum points in a number of countries which are, on balance, either large losers or large receivers of population. Confirmation of this view and details of the extent and complexity of population movements throughout the world are to be found in the Geneva documents on population.

TABLE V

IMMIGRATION INTO THE UNITED STATES OF AMERICA, 1901–10 AND 1929

COUNTRY OF LAST PERMANENT RESIDENCE OF IMMIGRANTS	NUMBERS IN THOUSANDS	
	1901–10 (Average)	1929
United Kingdom (including Irish Free State)	86.5	41.2
Russia and Finland	159.7	1.4
Sweden	25.0	8.9
Norway	19.1	6.0
Poland*	.....	9.0
Germany	34.1	46.8
Italy	204.6	18.0
Austria-Hungary	214.5	2.3
Czechoslovakia†	.....	4.4
Rest of Europe	70.1	20.6
Total: Continent of Europe	727.1	117.4
British North America	17.9	66.5
Mexico	5.0	40.2
Other countries	43.0	14.4
Grand total	879.5	279.7

* Included with Austria-Hungary, Germany and Russia.
† Included with Austria-Hungary.

IV

Under dynamic conditions, O and A are, as we have seen, not constant, but variable. Some, but not all, of the causes tending to change O and A are, or might be brought, within the control of the people affected. Migration the world over is being more and more stimulated or discouraged or regulated according to definite, but differing, policies. The problem of public health has been taken in hand; mortality and incapacity due to industrial disease are diminishing in many countries; and the gradual disappearance

of the "C.3" person is no longer a dream of the far-distant future. Unfortunately it is not possible to speak with similar assurance about wars. Modern wars are known to be much more destructive of human life and material resources than those of the past, but whether they are becoming more or less likely to occur is a debatable point. Actual numbers may also be influenced deliberately by way of the birth rate, but the effects upon production will necessarily be long deferred and uncertain. Probably, if *A* diminishes owing to a tendency—whether stimulated by deliberate public policy or not—toward limitation of the sizes of the families of the poor, an improvement in the average quality of the rising generation may be expected to result. In short, *A* may fall quantitatively, but rise qualitatively.

In Britain at present the largest families are found among the unskilled workers; the poorest class in the community. In the majority of the families of the unskilled not more than one child on the average becomes a skilled worker. The reasons are mainly economic. "As the family increases in number the economic strength of the family diminishes in proportion to the number of children born, but improves when the eldest child obtains employment, provided the husband continues to work."[15] The eldest child has, as a rule, a very poor chance of becoming a skilled worker because pressure of poverty generally forces him or her at the school-leaving age into some unskilled occupation where the initial earnings are greater than they would be if a beginning were made in some skilled trade. A tendency to marry early is also most marked among the unskilled. Their housing is generally extremely bad; their means of livelihood insecure; the earnings of the majority are so low that they exist upon or below the subsistence minimum. This state of affairs undermines the health and stamina of the children, and sometimes, having secured an apprenticeship, they prove too weak to continue the work. Many persevere and show capacity not inferior to that of the average young person in more fortunate economic and social circumstances, but many others have little regard for education and apprenticeship, and no interest in the future. The evil influences of their

[15] Cf. E. L. Lewis, *The Children of the Unskilled* (London, 1924).

environment have proved too much for them. They are forced to concentrate upon immediate problems in order to live, and this holds them down to the low standards of their class. For the most part it appears that they do not lack ability so much as opportunity. The problem is to turn potential quality into actual quality.

One of the reports to the International Economic Conference of 1927 stated that "as a rule the more rigid restrictions [upon emigration] are to be found in countries in which economic difficulties encourage the wish to leave the country, but in which the Government proposes to overcome these difficulties or at least to control the process."[16] Clearly this might be an onerous task for any government to undertake, and failure might mean a considerable divergence between *O* and *A*. But a government may feel impelled to make the attempt not so much by its complete confidence in its chances of success, as by what it regards, rightly or wrongly, as sheer political necessity. Restriction of immigration, for instance, may be dictated mainly, if not entirely, by non-economic motives; and just as a country may decide to forego an increase of numbers in spite of a high probability that such an addition would greatly enhance the productivity of the population as a whole, and bring *O* closer to *A;* so also may a policy of restriction of emigration be pursued upon non-economic grounds in spite of the certainty or high probability that in consequence *A* will continue much in excess of *O*. The chief of these motives is preparation for war. Statesmen who would rejoice to see increasing economic welfare within their countries are often disturbed by their fears of the menace, fancied or real, of prolific neighbors, and driven by their apprehensions to pursue a policy antagonistic to the actual or approximate coincidence of *A* and *O*. The probability of war, sooner or later, commonly begets a tendency to glorify a numerous population and the ideal of economic self-sufficiency. Professor Cannan says:

> Most of the stock arguments for Protection are at bottom "national security" arguments. It is alleged to encourage the growth of population, and

[16] *Report on Legislation Concerning the Movement of Labour*, C.E.I.12 (Geneva, 1926), p. 8.

the chief recommendation of a large population is that victory in war goes to the big battalions. It is intended to provide self-sufficiency, and the chief recommendation of self-sufficiency is that the self-sufficient country can stand a blockade.[17]

A sustained attempt to make any country self-sufficient would, unless the circumstances were very exceptional, tend to decrease income per head. Facilities for economic co-operation would not be fully utilized. Probably there would be much fostering of feeble industries, much growing of oranges in Scotland. "Defense," in such cases, is represented as paramount, a matter of primary importance; while the increase of economic welfare falls into a secondary position. If war actually occurs it means almost inevitably terrific destruction of the resources of the belligerents, including the best of their human resources—healthy men in the prime of their working lives. Therefore war is likely to cause decreases in A and O. Also there may be post-war changes, such as the surrender of territory, which are likely to cause variations of O. It seems almost impossible that alterations of frontiers, especially if they sever natural economic units, can leave unchanged the most desirable densities of populations in any of the areas affected.

V

Although for purposes of study and exposition we may single out certain causes of variations of the optimum, actually numerous causes may operate concurrently. Thus, a given population may be increasing both naturally and by immigration, while at the same time the age-distribution may be changing more or less rapidly. The change in the age-distribution over a given period may be the result of several causes, such as changes in the birth and death rates, immigration *minus* emigration, war, and epidemics. Where the influences are opposed and approximately evenly balanced, the disturbance of productivity and the variation of the optimum may not be great; but, on the other hand, where the disturbing influences are complementary the variation of the optimum, either up or down, may be expected to be considerable. Disease in one form or another tends to diminish most

[17] Cannan, *An Economist's Protest* (London, 1927), pp. 414–15.

the numbers of the very young and the very old; but war, by a process of reverse selection, diminishes the numbers of the most able-bodied and virile adult males only. Hence we get changes in the efficiency of workers and in the proportion of workers to non-workers. In recent times, within the space of a few years, the population and productive power of the United Kingdom were affected by war on a colossal scale, a series of severe influenza outbreaks, and a fall in the quantity of emigration coupled with a tendency toward a change in its quality. Simultaneously, over the period under discussion, the attempts to reduce the rate of juvenile mortality proceeded steadily and successfully. Again, we may consider Russia between 1914 and 1924, with her enormous losses of men in both external and internal wars; the dislocation of normal trade and transport; the reaction of internal chaos upon productive activity; and the further reduction of product and population during the great famine. Here the preponderance of pressure seems to have been so far distinctly in the direction of a diminished product per head, in spite of the efforts of the Soviet government to revive and reconstruct.

ALFRED PLUMMER

RUSKIN COLLEGE, OXFORD

HOLLAND, SWITZERLAND, AND BELGIUM AND THE ENGLISH GOLD CRISIS OF 1931

TO A considerable degree, discussion of the abandonment of the gold standard by England in September, 1931, has overemphasized the rôle of France. There were really four important actors in that drama. It is the purpose of this paper to estimate the part played by Holland, Switzerland, and Belgium as recipients of England's gold, as well as to indicate the forces at work, and the motivation behind the events which climaxed on September 21.

I

France, and these three smaller nations, were the only countries of appreciable importance in the gold drain which England underwent in the summer of 1931. The United States played a comparatively unimportant rôle in the flight from London; while Sweden, in regard to whom there has been some suspicion, we find to have taken a very minor part, and that quite against her will.[1] Nor need we pay attention to compensating specie exports to England from the four countries, for these were negligible.[2]

During the portion of the year significant for our purpose—from May through September 21, 1931—England's gross gold export to these four countries was approximately £53,547,522, representing a net export surplus of gold for the summer of about 18 million pounds. Of the gross amount, about £26,090,463 went to France; and £27,457,059 to Holland, Switzerland, and Belgium. (Cf. Tables I and II.)

Switzerland was the first country to receive any unusual amount of specie from London, importing in two weeks in June

[1] The gold stock of the Riksbank increased only from 199 to 206 million kroner, January 1 through September (*Skandinaviska Kreditaktiebolaget*, January, 1932, p. 13). Cf. *The Economist*, October 10, 1931, p. 662, for an analysis of the Swedish relation to the European crisis.

[2] For complete figures, see the *Weekly Bullion Letter* of Samuel Montagu & Co., London.

(June 1–8 and June 15–22) about £685,860, approximately 12 per cent of the whole amount of gold she was to receive therefrom up to September 21.

But it was the period of July 13 to August 10 which brought the most severe and sudden call upon the English gold resources. During that time France took £24,532,221, 93 per cent of her total

TABLE I

UNITED KINGDOM GOLD EXPORTS*
(In Thousands of Pounds)

Date	Holland	Switzerland	Belgium	France	Austria	Germany
April 27—May 4	.....	.....	.....	13	.....	.....
May 4–11	.....	.....	.....	14	11	12
May 11–18	.....	.....	.....	18	.....	30
May 18–23	.....	21	.....	10	6	7
May 23—June 1	.....	.....	.....	12	33	37
June 1–8	.....	389	.....	21	25	40
June 8–15	17	16	.....	13	66	386
June 15–22	19	266	.....	27	130	539
June 22–29	9	14	.....	12	.....	244
June 29–July 6	11	.....	.....	21	.....	258
July 6–13	5	7	.....	14	.....	453
July 13–20	2,833	46	1,615	3,452	49	66
July 20–27	5,673	207	344	10,990	88	23
July 27—Aug. 1	2,656	201	927	8,904	24	.....
Aug. 1–10	1,957	81	1,052	1,186	31	.....
Aug. 10–17	609	40	.....	38	37	.....
Aug. 17–24	507	1,391	.....	1,103	.....	.....
Aug. 24–31	1,209	1,078	150	30	18	.....
Aug. 31—Sept. 7	22	1,310	4	42	7	.....
Sept. 7–14	118	721	.....	89	9	.....
Sept. 14–21	1,884	46	.....	20	51	17
Sept. 21–28	2,183	10	.....	17	26	.....

* From *The Weekly Bullion Letter* of Samuel Montagu & Co., London.
Also exports to the United States of £309,500, July 20–27, and £211,000, September 21–28.

receipts from England from May to September 21. Switzerland, for some reason, was slow to follow up her earlier draft; and in this hectic month drew only £534,757, or 9 per cent of her eventual total. Holland, on the other hand, now received £13,118,372, three-quarters of her summer's total. And Belgium was, in proportion, even more precipitate than France, drawing £3,938,034, or nearly 96 per cent of her whole taking.

This period, from July 13 to August 10, it should be remembered, included some of the high-tension points of the summer.

On July 13 the great Darmstaedter und National Bank failed, and there followed drastic financial decrees by the Bruening government. The London Conference, July 21–23, was a token of the gravity of the European situation. July 23 and 30 saw full-point increases in the Bank of England rate. On August 1 a 50-million pound Franco-American credit to the Bank of England was announced; and the Bank secured permission for an increase of the fiduciary issue. On August 6 a mistaken rumor that France had

TABLE II

GOLD EXPORTS FROM THE UNITED KINGDOM

TOTALS OF TABLE I

(In Thousands of Pounds)

1931	Holland	Switzerland	Belgium	France	United States
May	.....	21	.....	67	.....
June	45	686	.....	73	.....
July	11,177	461	2,886	23,381	310
August	4,282	2,590	1,203	2,417	.....
Aug. 31—Sept. 21	2,024	2,077	4	152	*
May—Sept. 21	17,529	5,836	4,092	26,090	310

* United States, September 21–28, £211,000.

ceased supporting the pound caused a considerable flurry. And throughout, further drastic governmental action in Germany emphasized the serious state of affairs.

The period from August 10 to September 21 does not reveal so clear-cut a peak as the preceding, but rather the continuation of heavy, irregular strain. Switzerland, indeed, reached its own high point from August 17 to September 14, when it received from London about £4,500,236, or three-quarters of its summer's total. Holland's imports remained considerable, save for two weeks (August 31 to September 14); and her drain of £1,884,395 in the week preceding the 21st is credited by some with having laid the last straw. Belgium by this time had ceased receiving specie from England.

These final six weeks were the period of the new National Government (August 25), the second ($400,000,000) Franco-American loan to the Bank of England (August 28), the private Stand-Still

Agreement (September 9), the "mutiny" of the fleet (September 15), and the rumors of Conservative action to bring on a general election—all of which was reflected in extremely heavy liquidation on Continental exchanges, particularly in the third week of September.

The drain on England inevitably played its part in the significant redistribution of the world's gold which occurred during the year. Whereas the three smaller nations under consideration accounted for about 10.1 per cent of the world's gold at the beginning of 1931, their percentage had risen to 17.8 by the end of the year. The American share dropped from 39.2 to 35.8, the English from 9.3 to 7.1, and the German from 6.9 to 2.8 in that period. The French proportion, on the other hand, rose from 27.7 to 32.4. The proportional shift in the case of the three smaller countries was, therefore, greater than for any of the larger.[3]

TABLE III

DEPOSITS AND STERLING BILLS HELD IN LONDON ON FOREIGN ACCOUNT, AS OF MARCH 31, 1931*

(In Thousands of Pounds)

Deposits with—		
Bank of England, clearing banks, Scottish banks...	146,164	
Accepting houses.....	81,019	
Total.....		227,183
Sterling bills held through—		
Bank of England, etc.....	136,814	
Accepting houses.....	7,380	
Total.....		144,194
Advances to discount market—		
By certain foreign banks, etc.....		35,700
Aggregate of deposits, bills, and advances.....		407,077

* *Report of Commission on Finance and Industry* (MacMillan Report), pp. 299–301, Tables 9, 10, 11.

Unfortunately, our knowledge of the respective holdings of the small nations in London, and the degree to which these had been withdrawn by September 21, is limited to reasonable guesses upon the basis of the figures given in the MacMillan Report with the addition of scattering rumors. (Cf. Table III.) It seems probable,

[3] "Commercial History and Review of 1931," *The Economist*, p. 10.

however, that, as in the very similar "run" on Germany, these countries managed to withdraw only relatively small portions of their holdings; they still had large balances in London when the gold standard was abandoned.[4]

What importance, then, is to be attached to the withdrawals of the smaller nations? Some opinion has assigned decisive importance to the last-week Dutch withdrawals in forcing the decision of the Bank and the government.[5] On the other hand, it has been inferred from Mr. Snowden's remarks to the House of Commons that "it was not so much the terrible onslaught against the British currency and British securities which prompted the decision, as the conviction acquired, that fresh credits could not be obtained in the United States."[6]

Again, in perspective, the real reason for the abandonment of the gold standard may be seen not in the actual drain of the summer but in the long-run threat of the future weeks. For the net gold loss during the crisis, of only some 18 million pounds, seems a comparatively small amount to have forced the decision of September 21.[7] That it did so, may have been because the Bank of England and the government, despairing of seeing the end of the "run" within any reasonable time,[8] and unable to secure further adequate loans abroad,[9] felt it wiser to preserve the gold stock than to permit its exhaustion to no purpose.[10]

[4] The Bank of France held 60 million pounds in England at the abandonment of the gold standard ("Summary of Annual Report of the Bank of France," *Federal Reserve Bulletin*, March, 1932, p. 162). It has been rumored that the French commercial banks had withdrawn all but 10 million pounds of their English holdings by September 21.

[5] Alexander D. Noyes, *New York Times*, September 21, 1931, p. 22. Cf. a London dispatch, p. 25 of the same issue.

[6] *Ibid.*, October 4, 1931, Sec. III, p. 3. Cf. Snowden's speech, *ibid.*, September 22, 1931, pp. 1 and 16.

[7] Cf. A. J. Liversedge, *Bankers' Magazine*, November, 1931, pp. 658 ff.

[8] Cf. *New York Times*, November 23, 1931, p. 31, where this is stated as the consensus of opinion in "The City."

[9] Cf. Mr. Snowden's remarks, referred to above.

[10] With about 53 million pounds withdrawn from England by September 21, on the basis of the figures of the MacMillan Report (Table III), London must have still been liable to call for around 300 million pounds of deposits and bills held for foreign account. How much of this was held by investors, bankers, and central banks of

The long-run view aside, however, the gold drain of 1931 remains the immediate source of the fall of the gold standard, and in that drain Holland, Switzerland, and Belgium were clearly of even greater quantitative importance than France.

II

What particular institutions or individuals were responsible for the flight of gold to these countries, we cannot, from the information at present available, determine with any certainty. The three important agencies, however, were probably private investors, foreign commercial banks, and foreign central banks.

There is general agreement that private investors played an important rôle in the flight from the pound. "The money markets" and the private "holders of capital" were responsible, *Le matin*

---

the four leading drawing countries, we have no reliable means of telling. But, as we do know that on September 21 the Bank of France itself alone held 60 million pounds in London (cf. note 4 above), it seems reasonable to suppose that at least a half to two-thirds of the remaining short-term obligations of London were subject to call by the various interests in the four countries which had already been almost the exclusive recipients of the English gold. There was, thus, ample basis on which the "run" might proceed, even if the drain simply kept up toward these four; and obviously the Bank's remaining gold stock of about 130 million pounds could not satisfy a continued heavy liquidation of these large holdings. As this was the view apparently held in "The City" (cf. note 8 above), it is not unreasonable to suppose that it entered into the official calculations.

It has been suggested by Mr. A. J. Liversedge (*op. cit.*) that the importance of the net gold loss of 18 million pounds was due to the fact that it climaxed a gold drain of a decade, in which England's export surplus of gold, 1920–30, had amounted to £105,369,000. The figures are confusing, but it does not seem that the specie resources of the Bank suffered any such strain in this period. Rather, the gold stock of the Bank remained very stable from 1920 to 1925 (these figures include gold in the treasury as well as in the Bank). The net decrease which resulted from the gold movements of 1925–30 amounted only to £16,480,000, and the end of 1930 brought a considerable recouping of this decline. Further, the Bank's holdings of coin and bullion totaled £146,557,914 on January 7, 1931, and £148,482,514 on May 6, 1931, so that the quarter preceding the beginning of the European financial crisis saw a further gain of nearly two million pounds in the gold stock (cf. League of Nations, *Memorandum on Currency and Central Banks*, II [1913–25], 38–39; and Gold Delegation, *Selected Documents on the Distribution of Gold*, C. 102 M. 38, 1931, II. A., p. 33).

It seems probable that Mr. Liversedge's 105 million pounds surplus of gold exports does not really represent a direct drain upon specie held within England itself. During the war and post-war period, gold was accumulated by the Bank of England

remarked.[11] And *The Economist* called the flow of refugee capital to Holland and Switzerland at this time "enormous" and "notorious."[12] During the crisis, Amsterdam banking opinion disclaimed responsibility for the specie flow to Holland: "The gold influx is described here as unavoidable, owing to the large amount of home and foreign capital seeking safety in Holland."[13] Leading Swiss bankers (notably Dr. Jean Musy, chief of the Federal Department of Finance,[14] and Dr. R. G. Bindschedler, of the Credit Suisse)[15] were no less emphatic as to the responsibility of the private investors; and the annual report of the Swiss National Bank pointed out as "one of the most striking features of last year," "the sometimes simultaneous recall of Swiss capital deposited abroad, and the influx of foreign funds."[16] The abnormal increase in currency circulation in the small countries probably affords tangible evidence of this flight, in that much of the fleeing capital

---

in the dominions, particularly in South Africa. Hence, "satisfactory conclusions are not to be drawn from published figures of exports and imports [of gold] in the war and post-war period concerning the net movement in gold supplies held by Great Britain. The difficulty is that exports have been exaggerated, for gold not included by the customs officials when imported [i.e., when credited to the Bank's account abroad] has been included when exported [i.e., when drawn as against these foreign balances]." Thus, an apparent 90-million pound gold export excess (1920–24) is probably explained by the fact that "gold purchased from South Africa was accumulated during the war and early post-war period, and hence exports [from 1920 to 1924] were in excess of current receipts from the South African mines" (S. E. Harris, *Monetary Problems of the British Empire* [New York, 1931], pp. 322 and 326). If this interpretation is correct, then the great ten-year export surplus of gold turns out to have been a draft upon resources stored up outside of England itself. In any event, it seems clear that the gold resources of the Bank of England do not witness any such drain upon the Bank itself. Hence, it seems that our first guess, above, is more probably correct, and that the 18-million pound net loss in the summer of 1931 drew its significance from the fact that it was taken as presaging a continued "run."

[11] Leader of October 13, 1931, quoted in *New York Times*, October 15, p. 7.

[12] January 16, 1932, pp. 105–6. Cf. *The Economist's* "Commercial History and Review of 1931," p. 10.

[13] *New York Times*, September 28, 1931, p. 31.

[14] Swiss Banking Corporation, *Bulletin mensuel*, October, 1931, p. 194.

[15] *Credit Suisse Bulletin Financier*, September, 1931, pp. 177–80.

[16] Reported in *The Economist*, March 19, 1932, p. 631.

did not seek banks but was hoarded in whatever currencies were thought safe[17] (cf. Table IV).

Just what part Englishmen played in this flight from London, we cannot tell. The official statement of September 21, indeed, declared that "undoubtedly the bulk of withdrawals has been for

TABLE IV

NOTE CIRCULATION*

(In Millions)

1931	Belgium (Francs)	Holland (Gulden)	Switzerland (Francs)
May	16,092	837	990
June	15,967	879	1,078
July	16,791	932	1,255
August	16,613	934	1,293
September	17,283	1,035	1,462
October	18,008	1,037	1,498
November	17,748	1,051	1,477

NOTE CIRCULATION AT SIGNIFICANT DATES†

(In Millions of Dollars Computed at Par)

	Jan. 10, 1931	Sept. 19, 1931	Oct. 31, 1931
Bank of England	1,771	1,710	1,733
U.S. Federal Reserve banks	1,625	2,006	2,384
Bank of France	3,042	3,040	3,279
Reichsbank	1,032	1,010	1,130
Netherlands Bank	335	380	417
National Bank of Belgium	453	464	500
Swiss National Bank	188	246	288

* *The Economist*, December, 1931, Supplement, p. 46.

† *Ibid.*, January 16, 1932, p. 105.

foreign account."[18] But, on the other hand, a leading exponent of British banking opinion, the *Bankers' Magazine*, severely scored its countrymen for participating appreciably in the "run."[19]

As between the private and the central banks of the gold-importing countries, we must place by far the greater responsibility upon the former. Financial opinion unanimously refers the banking aspect of the drain to the commercial banks of the drawing countries: the chairman of the National Provincial Bank spoke

[17] *Ibid.*, January 16, 1932, p. 106.

[18] *New York Times*, September 21, 1931, p. 1. [19] October, 1931, p. 492.

for many others, in relating the crisis to the fact that "*the foreign bankers* . . . . began to doubt the ability of London to repay the funds that had been placed here."[20] The emphasis upon "the banking interests" likewise runs through *The Economist's* Geneva and Amsterdam dispatches of the summer.[21]

On the French side, the division of responsibility seems to be similar. A careful investigator stressed "the desire of the French banks to have an impregnable cash position" as the immediate force in bringing specie across the Channel.[22] The Bank of France, he continued, was quite powerless to check the full tide of the movement. From all available indications, the same was true of the smaller central banks.

Finally, the official British statement of September 21, and Mr. Snowden's explanatory speech to the House, indicated that the government's explanation of the event also ascribed the chief responsibility to the foreign commercial banks rather than to the central institutions, which are mentioned only in praise of their co-operation.[23]

Confirmation of this judgment is afforded by such records of central banking opinion and action as are now available. We know, for example, that official opinion in Switzerland was averse to the great inflow of specie;[24] and, according to the *Acceptance Bulletin*, active support was extended the pound by the Swiss National Bank, which "bought gold in the open market—at times at a fairly dear price, in competition with Dutch buyers—lodged the bullion at the Bank of England, and released a roughly equivalent amount of sovereigns, thus swelling the Bank's reserves."[25]

The annual reports of the smaller central banks, too, seem to

[20] Sir Harry Goschen, Annual Report to the Stockholders, *The Economist*, January 30, 1932, p. 254; italics mine. Cf. other annual reports in *The Economist* of January and February.

[21] Cf. *The Economist:* July 25, 1931, p. 173; August 1, pp. 222–23; August 29, p. 394; September 5, p. 433; September 19, p. 519; September 26, p. 563. Cf. also, *Acceptance Bulletin*, August, 1931, p. 13; October, 1931, pp. 5 and 13, for quotation from Westminster Bank *Bulletin*.

[22] Walter R. Gardner, in *American Economic Review*, March, 1932, pp. 60–61; and p. 63 for note on gold hoarding by the commercial banks.

[23] *New York Times*, September 21, 1931, p. 1; September 22, pp. 1 and 16.

[24] Cf. statement of Dr. Musy, *op. cit.;* also *Acceptance Bulletin*, June, 1931, p. 4.

[25] September, 1931, p. 13.

indicate that these institutions did not predominate in the drain on London. For example, of the 1,140,000,000 francs imported into Switzerland through banking operations in 1931, the Swiss National Bank itself imported 474,000,000 francs, or about 40 per cent. But this includes the period *after* September 21, when the gold drain on New York occurred; and the National Bank's decided action at this time, involving the conversion of $90,000,000 of exchange within a month (cf. Table VI), would explain most of the Bank's specie imports—particularly in the light of what is known of official opinion toward the British crisis and of the central bank's gold-buying operations in London.[26]

That it was not the central banks which were repatriating London deposits, and converting short-term credits into gold, seems to be borne out by the almost static condition of the items of "foreign bills," or "foreign bills and balances abroad," in the weekly statements of these institutions (cf. Table V). The record of the National Bank of Belgium showed the only decided change—a decrease of £1,300,000 in these items—and even if all this related directly to the British crisis, it would reflect a minor portion of the total specie flow to Belgium. The foreign-exchange holdings of the Swiss National Bank throughout the crisis increased rather than decreased.[27] The only change in the "foreign-bills" item of the Netherlands Bank account during the summer was a slight increase. Holland, it must be remembered, was quantitatively the most significant of the three small countries in the withdrawals.

Finally, the rumor that certain of the European central banks were given verbal guaranties against loss on their short-term sterling assets, at the time of the abandonment of the gold standard, may indicate another reason to believe that the Continental institutions did not join in the flight from London.[28]

[26] *Federal Reserve Bulletin*, May, 1932, p. 251.

[27] While the immediate post-crisis figure, for September 23, shows a decrease of £3,700,000 in the holdings of the Swiss National Bank, the figure on September 15 stood only £200,000 below that of September 7; and the heavy withdrawals from England on the part of Switzerland ended even a week before this. Thus, the final decrease in the Swiss National Bank holdings must probably be attributed to the beginning of the drain on the United States.

[28] Cf., for example, Lippmann and Scroggs, *The United States in World Affairs 1931*, p. 213.

All this, of course, is not to deny that the Belgian, Dutch, and Swiss central banks *did* move gold in 1931, but only to assert that their important specie imports were apparently out of the United States rather than England. For after September 21, they did

TABLE V

CENTRAL BANK HOLDINGS ABROAD, AND NATIONAL GOLD IMPORTS*
(In Thousands of Pounds, Computed at Par of Exchange)

"Amount of Foreign Bills and Balances Abroad"		Gold Received from England	
NATIONAL BANK OF BELGIUM			
July 2	25,000		
July 30	24,900	July	2,886
Aug. 6	24,000		
Aug. 27	23,500	August	1,203
Sept. 3	22,500		
Sept. 17	23,700	Sept. 1–21	4
NETHERLANDS BANK			
July 6	19,040†		
July 27	19,060	July	11,177
Aug. 3	19,150		
Aug. 31	19,160	August	4,282
Sept. 7	19,140		
Sept. 21	19,260	Sept. 1–21	2,024
SWISS NATIONAL BANK			
July 7	16,700		
July 31	18,700	July	461
Aug. 7	19,900		
Aug. 31	22,600	August	2,590
Sept. 7	22,800		
Sept. 23	19,100	Sept. 1–21	2,077

* From weekly central bank reports, *The Economist.*
† "Foreign bills" only, throughout.

move gold very dramatically from this country. The effect of the fall of the pound was to destroy "faith in the safety and efficacy of the gold exchange standard [which, in practice, these three had hitherto maintained], since foreign central banks found their sterling exchange, which they had legitimately held as part of their

legal reserves, to have depreciated," and they now feared that their dollar holdings might soon involve them in a similar loss.[29]

Under the spur of this fear, the central banks proceeded quickly to curtail their holdings of exchange, as "the result of a definite policy."[30] Between September 19 and October 31, the Dutch hold-

TABLE VI

CENTRAL BANK HOLDINGS OF FOREIGN EXCHANGE*
(In Millions of Dollars Computed at Par)

	Jan. 10, 1931	Sept. 19, 1931	Oct. 31, 1931
Bank of England	.....	.....	.....
U.S. Federal Reserve banks	.....	.....	.....
Bank of France	1,038	1,078	1,082
Reichsbank	95	85	31
Netherlands Bank	99	92	35
National Bank of Belgium	132	116	.....
Swiss National Bank	66	109	19

* *The Economist*, January 16, 1932, p. 105.

TABLE VII

GOLD HOLDINGS OF CENTRAL BANKS ON SIGNIFICANT DATES*
(In Millions of Dollars, Computed at Par of Exchange)

	Jan. 10, 1931	Sept. 19, 1931	Oct. 31, 1931	Jan. 9, 1932
Bank of England	710	660	660	588
U.S. Federal Reserve banks	2,994	3,486	2,738	2,986
Bank of France	2,118	2,296	2,534	2,695
Reichsbank	527	321	266	234
Netherlands Bank	171	267	336	354
National Bank of Belgium	191	224	357	354
Swiss National Bank	138	234	422	464
Bank of Sweden	65	61	57	54

* *The Economist*, January 16, 1932, p. 106.

ings fell over 60 per cent, the Swiss over 80 per cent, and the Belgian vanished entirely. This shift in policy was reflected in the very marked changes in central-bank gold holdings over the same period. (Cf. Tables VI and VII.) But this flight from the gold exchange standard is another story.

[29] *The Economist*, October 10, 1931, p. 646. *Ibid.*, p. 646: the drop in central bank deposits with the B.I.S. during September, from 869.9 million francs to 624.5 millions probably likewise reflects this change of policy.

[30] *Ibid.*, January 16, 1932, p. 106.

III

The repatriation of London balances probably took the form chiefly of the recall of deposits, the conversion of short-term credits, and the liquidation of English securities, or at least of securities held in England.

The MacMillan Report indicated large deposits in England on foreign account, and it is reasonable to suppose that these provided a considerable proportion of the specie drain (cf. Table III). Likewise, the sterling bills held through the Bank of England and the joint-stock banks would also have provided an easy way to liquidation.

Securities sales in London form a more imponderable item; but the history of the European stock exchanges, parallel with the unfolding of the crisis through July and August, indicates that the liquidation of stock holdings in England provided much of the repatriated funds. The "peak" month, July 13 to August 10, saw growing sales, and "extreme" liquidation, directly attributed to sales by foreign holders.[31] In the following period of strain the same tendencies were observed; and the sensational drop in Kreuger and Toll early in September was attributed directly to Swiss pressure, of which "the main cause was undoubtedly anxiety to obtain liquid resources after the 'freezing up' of assets in Germany and Central Europe."[32] "Growing and heavy Continental liquidation" was noted on the London Exchange in the week preceding the abandonment of the gold standard.[33] The movements in the quotations of the 5 per cent War Loan, "regarded as a key security by virtue of its amount and extensive foreign holdings," were also taken to reflect such liquidation.[34] Thus, the War Loan fell to $103\frac{1}{8}$ at the beginning of the heavy drive on the pound, steadied again, and remained at its former figure of $103\frac{1}{2}$ until the last half of the "peak" month, when it began a decline which brought it to $101\frac{7}{8}$ by August 5 and to $100\frac{7}{16}$ by the end of that month.

[31] *Ibid.*, July 18, 1931, p. 133; July 25, p. 179; cf. August 1, p. 227; August 8, p. 278.

[32] *Ibid.*, September 5, 1931, p. 443.

[33] *Ibid.*, September 19, 1931, p. 525.

[34] *Ibid.*, September 19, 1931, p. 572.

IV

The fear which prompted the flight from the pound represented —aside from its general basis in the prevailing political uncertainty—the interweaving of three financial, or economic, factors: the Central European crisis, the developments of the summer within England itself, and the increasingly unstable financial and banking situations within Belgium, Holland, and Switzerland, as well as France.

When, on May 11, it became known that the Credit Anstalt of Vienna, the key banking house of Central Europe, was in grave difficulties, the announcement rocked the whole economic structure of the Continent, "shook confidence in the financial position of Austria; and the position of Germany also began to give rise to apprehension."[35] There followed a flight from the mark, which the Hoover Moratorium failed to check, and which reached its climax on July 13 with the closing of the Darmstaedter und National Bank. Drastic governmental decrees kept order in the German financial structure, but the outcome of the crisis was necessarily the agreement to freeze Germany's short-term credits. Germany's plight, and the freezing of the short-term obligations, had a very immediate significance for the three small nations.

For Holland and Switzerland, particularly, had large holdings in Germany (cf. Table VIII). Switzerland had the larger interest, holding 13.9 per cent of Germany's short-term obligations, while Holland held 9.7 per cent. As the banking interests of both were also "very closely involved" in the Austrian crisis, they felt keenly the uncertainty which the events up to mid-July had already introduced into their situations.[36] Indeed, the Dutch interests were so alarmed that their assent to the obviously necessary Stand-Still Agreement was given very reluctantly, and apparently only under pressure from the Netherlands Bank.[37]

Switzerland's involvement in the German crisis was also com-

[35] *Course and Phases of the World Economic Depression* [Secretariat of the League of Nations, 1931] pp. 298 ff. Cf. Lippmann and Scroggs, *op. cit.*, chaps. vii and viii.

[36] Cf. *The Economist*, July 25, 1931, p. 173.

[37] *The Commercial and Financial Chronicle*, September 26, 1931, p. 2009, quotation of a London dispatch to the *New York Herald Tribune* of September 20.

plicated by the fact that her investments there were largely for account of foreigners, who might become the more restless for the safety of their funds because they were removed from them by an extra step. Indeed, "the situation might be embarrassing, should the foreign investors—mostly French—be compelled to ask at the same moment for the repayment of their money."[38]

The fear aroused by the Austrian and German developments was vividly demonstrated in the speed with which the Dutch and Swiss interests fled from Germany before the imposition of exchange regulation. The Americans drew the largest absolute

TABLE VIII

FOREIGN HOLDINGS OF SHORT-TERM CREDITS IN GERMANY*
(In Millions of Reichsmarks)

	MAR. 31, 1931		MID JULY, 1931		DIFFERENCE	
	Amount	Percentage	Amount	Percentage	Amount	Percentage
United States...	2,093	37.1	1,629	37.1	464	37.2
England.....	1,153	20.4	1,051	23.9	102	8.2
Holland.....	546	9.7	336	7.6	210	16.8
France.....	369	6.5	297	6.8	72	5.8
Switzerland.....	785	13.9	581	13.2	204	16.4
Sweden.....	122	2.2	101	2.3	21	1.7
Others.....	571	10.2	398	9.1	173	13.9
Total.....	5,639	100.0	4,393	100.0	1,246	100.0

* Annex V, "Report of the Committee Appointed on Recommendation of the London Conference, 1931" (Wiggin Report). *The Economist*, August 21, 1931, Supplement, pp. 6–7.

amount from Germany up to mid-July; but proportionately, the smaller countries made a more rapid exit: Holland taking nearly 40 per cent of her holdings and Switzerland over a fourth of hers, the two accounting for a third of the short-term funds recalled from Germany during the flight (cf. Table VIII). The fact that the foreign position of the Swiss banks, for example, was not such as should have caused alarm normally (their total long- and short-term holdings abroad at this time are reliably estimated as not more than 15 per cent of their aggregate engagements in these forms) emphasizes the panic which must have been felt to precipitate withdrawals on the scale which actually occurred.[39]

[38] *The Economist*, September 5, 1931, p. 433.

[39] *Ibid.*, October 10, 1931, p. 664.

Thus, by mid-July the small countries had had their fingers well burned, in the immobilizing of their German assets.[40] The lesson was soon to be applied. For England was now fully suspect, and the second figure in the pattern of Continental fear emerged.

England's creditors believed that she was very heavily embarrassed by the Austrian and German developments, and this belief was the root of the fear for her liquidity. From the Wiggin Report we know that she was, indeed, deeply interested in Germany; and in addition to whatever previous commitments she had had in Austria, there was now the 150-million schilling loan advanced to that nation by the Bank of England on June 16.[41] Responsible British banking opinion has then, and since, firmly declared that there was no justification for the fear for the soundness of the English position. "By every criterion of a century's practical experience," a statement from the Westminster Bank claims, "London's position was sound, given normal conditions. Neither to Germany, nor to any other country, had she advanced more than was judicious, having regard to all the known facts."[42] Rather than admitting any justifiable blameworthiness, Englishmen had boldly spoken for the wisdom of their lending policy. Mr. J. M. Keynes, for example, declared, with unwitting prophecy, in December, 1930, that

> we are such experienced lenders that we are trying at the present time . . . . to protect the position of all the creditor nations in the world almost unaided; and our apparent weakness is the result of our extraordinary strong mindedness up to date. We have been prepared to take risks in the interest of the international loan market.[43]

One is reminded of Professor Charles Rist's retrospective comment, that the pound fell "like a good soldier, fighting for the stability of the currencies of Europe." "London was having to 'carry' not only its own currency, but that of a large part of Europe."[44]

[40] Cf. the *New York Times*, September 28, 1931, p. 31.

[41] Cf. Lippmann and Scroggs, *op. cit.*, p. 131.

[42] *The Acceptance Bulletin*, October, 1931, p. 5. Similar statements will be found in the annual reports of all the leading banks.

[43] In *The International Gold Problem* (London: Royal Institute of International Affairs, 1931), p. 189.

[44] *The Economist*, October 3, 1931, p. 599.

What is important, however, is, not the English banker's caution or courage, or the true state of the facts as now known, but the aspect which the situation bore to England's creditors at the time.

Their interpretation of the situation is graphically demonstrated in the table of gold withdrawals. Mr. Snowden, in his official statement, frankly named as one of the two leading causes of the creditors' panic the knowledge of Britain's involvement in Germany.[45] After the freezing of the German credits, explained the chairman of the National Provincial Bank, "mistrust centered on London, because British banking was known to have treated Germany with more leniency than had been shown by other creditors; and foreign bankers, with their own difficulties increased by the Stand-Still Agreement, began to doubt the ability of London to repay funds that had been placed there."[46] And, as was to be expected, doubt became positive fear. We get an interesting reflection of the prevailing atmosphere in the estimate of a Berlin paper at the time of the crisis, that England was tied up in Germany, in short-term credits, to the extent of two billion marks, an exaggeration of nearly 100 per cent.[47]

But there were other factors besides this fear for British liquidity. Though, as Professor Rist has declared, the forces which led to the fall of the pound "were largely external to England itself,"[48] the events of the summer within that country contributed to the loss of foreign confidence. Certainly, two inopportune official reports played a significant part in creating the "peak" month of withdrawals, beginning in mid-July. The MacMillan Report, which appeared in June, made it clear for the first time to what a dangerous degree England's financial position rested upon short-term credits,[49] while certain inflationary aspects of the Report's

[45] *New York Times*, September 22, 1931, p. 1.

[46] Statement of Sir Harry Goschen, *op. cit.*, p. 254. Cf. *Acceptance Bulletin*, August, 1931, p. 13; *ibid.*, October, 1931, p. 5; also *Course and Phases of the World Economic Depression*, pp. 313–14.

[47] Cf. *Commercial and Financial Chronicle*, October 3, 1931.

[48] *The Economist*, October 3, 1931, p. 599.

[49] *Report of Commission on Finance and Industry*, pp. 149–50.

recommendations have also been judged to have aroused uneasiness abroad.[50]

Then on July 31 appeared the May Report on the budgetary situation, with its prediction of a $600,000,000 deficit to be met by new taxation. "The May Report, coming on the heels of the MacMillan Report, taught the world that the British budget as well as the British economy was seriously out of balance."[51] "Statements like these, coming from such authoritative sources, naturally caused apprehension in foreign centers."[52]

Succeeding weeks brought no relief of the tension. The meeting of the London Seven-Power Conference had been a token of the gravity of the situation. The increases in the bank rate, the uncertainty of the stock exchange, the increase of the fiduciary issue,[53] the formation of the National government, the exhaustion of two great loans to the Bank of England, the continued fall of the gold reserve below the 150-million pound figure of the Cunliffe Commission, all emphasized the precarious state of the pound. The "mutiny" of the fleet on September 15 suggested revolutionary possibilities to nervous foreign creditors,[54] and then came persistent rumors, fostered by the Conservative party press, that the Right group would force the coalition government to the uncertainties of a general election. The last-week drain to Amsterdam, which, as it were, cast the final ballot against the gold standard, was probably inspired considerably by these further developments in the British scene. Here, then, we have the broad European background of the fear which prompted the flight from the pound. The factors already considered explain largely the panic of the

[50] Cf. *Acceptance Bulletin*, August, 1931, p. 13; Lippmann and Scroggs, *op. cit.*, pp. 190–91.

[51] *Ibid.*, pp. 191–92. Cf. Snowden, *New York Times*, September 22, 1931, p. 1; also "Commercial History and Review of 1931," *op. cit.*, pp. 7–8; *The Economist*, January 30, 1932, annual reports of Williams Deacons Bank and Westminster Bank.

[52] *Acceptance Bulletin*, August 1931, p. 13.

[53] Cf. MacMillan Report warning: increase of fiduciary issue "would be interpreted as a sign of weakness, and be the occasion for nervousness at a time when the opposite effect on sentiment was to be desired" (p. 140).

[54] Mr. Snowden stressed the great impression which this created abroad.

private investors, and, to a degree, the fear of the banking interests.

But a fuller understanding of the position of the foreign bankers requires that we examine the unsettled financial situations existing at this time in the three small countries. For the desire to maintain domestic liquidity in the face of unstable local conditions was probably a still more important element in the bankers' withdrawals from London than was the simple wish to avoid loss by depreciation or freezing of their sterling assets.

The great flight of capital into the smaller countries had, in the first place, introduced a highly unbalanced element into their banking positions. Gold which had so fearfully fled Berlin or London might just as quickly, and embarrassingly, flee Amsterdam, Geneva, or Brussels; and this possibility required the maintenance of the greatest possible liquidity in the face of the deepening crisis.[55] A less obvious, but important, element in the bankers' uneasiness was the great fall in security values which marked the Continental exchanges throughout the summer. The index-of-security values on the Amsterdam market, for example, fell over one-fourth between July and September, while the decline was nearly 40 per cent in Switzerland from April to September (cf. Table IX). As the Continental banks held large participations in commercial and industrial undertakings, the persistent and drastic depreciation of these assets increased the bankers' sense of the instability of their position.[56]

The Austrian and German crises had also shaken the banking structures of the three small creditor countries. Belgium was apparently least touched; but, although there were no important bank troubles, the Bank of Brussels found it necessary to absorb a number of affiliates, to prevent strain. Holland had felt an immediate reaction of the Austrian crisis in the closing of the Amstelbank, an affiliate of the Credit Anstalt, and the intermediary bank

[55] Cf. *The Economist*, September 26, 1931, p. 563; also summary of annual report of the Swiss National Bank, *ibid.*, March 19, 1932, p. 631. Cf., too, statement of Dr. Musy, *op. cit.*, p. 186.

[56] Paul Einzig, *Journal of the Canadian Bankers' Association*, January, 1932, pp. 107 ff.

between Western and Central Europe; and there were several succeeding minor failures. The outstanding Swiss trouble was the failure of the Bank of Geneva, which was followed by several other closings and the forced reconstruction of several houses. Though, in retrospect, the three countries are seen to have weathered the storm quite successfully, at the time such troubles as these added to domestic uncertainty and increased the "passion for liquidity."[57]

TABLE IX

INDEX NUMBERS OF LEADING STOCK PRICES, 1931*

	Netherlands (49 Industrials)	Switzerland (32 Industrials)
April	64	199.5
May	56	179.8
June	50	180.7
July	51	169.4
August	45	157.1
September	37	122.6
October	37	129.3
November	39	131.9

* *The Economist*, December, 1931, Supplement, p. 48.

Probably the controlling element in the bankers' desire to strengthen their position was the evident decline of confidence in the banks and the consequent increasing danger of "runs." The uneasiness of the people was evidenced, for example, in the abnormal increases in the currency circulation in all three nations (cf. Table IV). Some of this represented hoarding by foreigners who had brought their funds thither but were unwilling to trust them to the banks.[58] But there was undoubtedly large domestic hoarding, paralleling the development of the European crisis.[59]

Another indication of lack of confidence in the banks was the steady fall in bank stocks. Uneasiness over Swiss financial relations with Germany and Central Europe, and the fall of bank

[57] *Ibid.*, p. 168, 170, 173. Cf. *The Economist*, September 5, 1931, p. 433; Swiss Banking Corporation, *Bulletin mensuel*, September, 1931, p. 179.

[58] *The Economist*, January 16, 1932, p. 106.

[59] Annual Report, Swiss National Bank, in *The Economist*, March 19, 1932, p. 631.

profits, were held to account for the "steady decline in bank shares" noted in that country. Likewise, "the heavy falls in Amsterdam quotations of shares of our big banks" was noted by a Dutch correspondent as a reflection of the German and English situations.[60] Thus, there was a general decline of a third to a half in the quotations during the summer (cf. Table X).

In addition to all this must be reckoned the deepening economic depression, now falling upon these countries for the first

TABLE X

DUTCH BANK STOCK QUOTATIONS*

	July 14, 1931	Aug. 14, 1931	Sept. 15, 1931
Amsterdam Bank	162¼	138¼	112
Koloniale Bank	110	99¼	66
Netherlands Ind. Handelsbank	107	99½	78
Netherlands Trading Society	127	120	87
Rotterdam Bank	.....	97¼	70

* *The Economist*, September 19, 1931, p. 528.

time in all its severity. Dispatches throughout the summer show a steady decline in industry, rising unemployment, etc.[61] Consider, for example, the confused situation in Holland: in addition to the German crisis and a very unsettled stock exchange, there came the prospect of a considerable budget deficit. Exports to Germany had dropped; France and Belgium had just put severe restrictions on coal imports from Holland; and to complete the disorganization of the foreign trade, there had been a great slump in the prices of the chief products of the Dutch East Indies, whose trade forms an important source of Dutch wealth. Finally, the sharp decline in American securities had meant heavy losses to many Dutch holders.[62]

The inevitable result of the combination of the bankers' fears of the freezing of their London credits and the development of domestic uneasiness was the maintenance of an exaggerated liquidity. The hoarding in itself tended to require drafts upon Lon-

[60] *Ibid.*, September 19, 1931, p. 519; September 26, 1931, p. 563.

[61] *Ibid.* Cf. Brussels, Amsterdam, and Geneva dispatches through the summer.

[62] *Commercial and Financial Chronicle*, September 26, 1931, p. 2009.

don, the money market for many European commercial banks, upon which the increased local demand for currency reacted. Holland's last-week drain on London was largely due to

> almost panicky conditions which . . . . developed on that market in consequence of drastic curtailments of credits by the Dutch banks. . . . . In their desire to attain greater liquidity [the Dutch Banks] had not only forced local liquidation, but had drawn substantially on their London balances. This brought down sterling at Amsterdam very sharply, and resulted in substantial withdrawals of gold from London.[63]

V

Did the central banks of Holland, Switzerland, and Belgium—to say nothing of the Bank of France—do all they might have done to prevent the fall of the pound? Lack of reliable information makes the question largely unanswerable now, but it ought to be said that the difficulties of the summer of 1931 were of such a scale and character as to leave the central banks practically powerless to control them.

"The enormously increased power of the banks outside the central banks . . . . may defeat the purpose of the central bank in its financial policy," as a leading British banker has emphasized.[64] Such would seem to have been the case, at least in France; and in the absence of definite information relative to the smaller countries, perhaps the French example can reasonably be taken as indicative of a general state of affairs.

The flow of gold to France ever since 1929 has been largely beyond the control of the Bank of France, Mr. Walter Gardner[65] points out. Hoarding, the commercial banks' desire for liquidity, the Oustric scandal, and other banking difficulties, combined with the legal restrictions upon the Bank of France, made the 1931 flow, in particular, impossible of central-bank control. It is probable that the situation of the other central banks was hardly better and that they rendered about all the aid possible to England in not participating significantly in the flight from the pound.

[63] *New York Times*, September 21, 1931, p. 25.

[64] Sir Charles Addis, in *The International Gold Problem*, p. 153.

[65] *Op. cit.*, pp. 60–61. Cf. Hawtrey, in *The International Gold Problem*, pp. 157–58.

Judgment of the unstable short-term position of London, which was at the heart of the English embarrassment, can hardly be as favorable. English banking had definitely got itself into the position of supporting a large long-term lending position on the basis of considerable short-term borrowings. The MacMillan Report recognized the dangers of the situation. "Before the War London's short term position with the rest of the world was probably well balanced. Today her gross liabilities for foreign short term bills and deposits are largely in excess of her claims in respect of her acceptances." Hence, the Report warned, there was "much more risk than there used to be of our financing long term investment by means of attracting short term foreign funds of a precarious character." British liabilities in 1931 "may be as much as double our liquid assets," concluded the Report recommending immediate strengthening of the liquidity of the Bank of England's position.[66]

The question raised by Dr. B. M. Anderson, Jr., whether England failed to fulfil her obligations in defending the pound, since the gold standard was abandoned with the bank rate at only $4\frac{1}{2}$ per cent, does not seem to involve as valid a criticism of British policy.[67] As English bankers apparently felt, it was probably true that the panic aroused by mid-July was of a depth not to be checked by any manipulation of the bank rate.

WILLARD HURST

WILLIAMS COLLEGE

[66] MacMillan Report, pp. 149–50.

[67] *Chase Economic Bulletin*, November, 1931. Cf. *New York Times*, November 23, 1931, for a British reply to this criticism.

TECHNOLOGICAL DEVELOPMENT OF THE AMERICAN POTTERY INDUSTRY

BEFORE the Civil War the potteries of the United States were, for the most part, small affairs, making crude, colored ware out of local deposits of clay and selling to nearby markets. White pottery for table use was imported.[1] When the Civil War interrupted the import trade, reducing the inflow of pottery from $4,138,838 in 1860 to a yearly average of about $2,500,000 for the succeeding six years,[2] American potters undertook the manufacture of white tableware.

After the war, when foreign exporters attempted to rebuild their American trade, they found our potters ensconced behind a high tariff wall. A contest for the American market ensued between foreign and domestic producers, the issue of which has not yet been decided. The tide of battle, however, has slowly and steadily turned against the foreigners. In 1860 more than 60 per cent in value of the pottery purchased, including even the coarse, cheap grades, bore a foreign trade-mark. In 1900 about 30 per cent was imported; in 1929 only about 15 per cent.[3]

The principal factors accounting for the competitive gains of domestic potters were increasing tariff protection and increasing manufacturing skill. The former factor reflects no credit upon our potters except as the sustained and increasing import duties indicate effective lobbying.[4] It is in the latter factor of manufacturing skill that we are now interested.

[1] U.S. Geological Survey, *Mineral Resources of United States* (1883), sec. 13, p. 544; *Hearings of House Ways and Means Committee* (47th Cong., 2d sess.), p. 241; *Report of Secretary of Treasury on Tariff Revision* (49th Cong., 1st sess.), p. 153; *Annual Proceedings of United States Potters' Association* (1879), p. 110.

[2] *Annual Reports of Department of Commerce: Commerce and Navigation.*

[3] *Commerce and Navigation* and United States Census of Manufactures. These figures are valuable in showing a trend, but they overestimate the relative competitive strength of American tableware potters because they include other forms of pottery than tableware and because they show invoice rather than landed value.

[4] The duties on decorated earthenware and decorated chinaware under the important tariff laws were as follows: 1861—china 30 per cent, earthenware 25 per cent; 1862—china 40 per cent, earthenware 35 per cent; 1864—china 50 per cent,

The steps in the manufacture of pottery[5] are: (1) the mixing of the materials, of which kaolin, ball clay, feldspar, and flint are the most important; (2) the washing, straining, magneting, and kneading of the body mixture to make it pure, homogeneous, and plastic; (3) the shaping of the ware; (4) the drying of the newly formed articles; (5) the first, or bisque, firing in the kiln; (6) the immersion in a glaze mixture; (7) the second or glost firing; (8) the decorating, and the final light firing to set the decorations.

The purpose of this study is not to make a contribution to the literature of pottery technology but to trace the rate of progress in manufacturing skill. The pottery industry has been unusually well protected by tariff legislation. Therefore it is important to learn whether the technology of the industry has been notably forward or notably backward and whether the rate of progress in technology has been satisfactory. As a means of arriving at a decision on these points we shall note significant differences in American and foreign manufacturing practice and in the readiness with which new methods have been adopted. Since our industry was a direct descendant of the English pottery industry, we shall find it profitable and feasible to make comparisons with England more often than with any other country.

---

earthenware 40 per cent; 1883—china 60 per cent, earthenware 60 per cent; 1890—same as 1883, but base upon which ad valorem rate applied was changed so as to bring about an increase in protection; 1894—china 35 per cent, earthenware 30 per cent; 1897—china 60 per cent, earthenware 60 per cent; 1913—china 55 per cent, earthenware 40 per cent; 1922—china 70 per cent, earthenware 50 per cent; 1930—china 70 per cent, earthenware 50 per cent and in both cases a specific duty of ten cents a dozen pieces is added.

[5] The word "pottery" is used to refer to clay products of widely different appearance and use. The most important of these is tableware with its closely allied products. The present study has to do mainly with tableware, although the problems of technology have many points of similarity in the entire pottery field.

In terms of texture or body composition, tableware may be broadly classified into earthenware and chinaware (or porcelain). Porcelain has a vitreous, or glassy-like texture. When of sufficient thinness it is translucent. Earthenware is not vitrified and hence is not translucent. Tableware pottery of American manufacture has been largely limited to earthenware. On the other hand, the bulk of our imported pottery should be classified as porcelain. Only earthenware of high artistry and long-established reputation continues to come into the country, although at one time, in the latter part of the nineteenth century, England sent large quantities of earthenware to America.

COMPARATIVE TECHNOLOGY, 1860–1914

Preparing the clay.—An important innovation of the second half of the nineteenth century was the filter press. When the body mixture came to the end of the mixing, washing, and purifying stage, it was in a liquid state. Before it could be shaped into dishes most of the water had to be removed. The common method, until after the middle of the century, was to heat the liquid in a slip kiln and evaporate the water. In 1856 the filter press was patented in England. This was a device which filtered the solution of clay and water through heavy canvas bags, removing the surplus water quickly and cheaply.[6] It was about twenty years or more before the filter press attained general use in the United States. Even as late as 1884 some Ohio potteries were still using the slow and expensive slip-kiln method.[7]

Forming the ware.—Most round pieces of pottery of standard size were made by the jiggering process. The essential elements of the process were: (1) a mold on which, or inside which, the ware was formed; (2) the revolving spindle or wheel on which the mold was set; (3) the profile tool of metal which pressed the ware firmly against the mold and gave it the proper thickness. As a preliminary to forming a plate or saucer, a "bat," or pancake of clay, was prepared. In America this bat was prepared by a youthful worker who wielded a heavy block of plaster of Paris. In England and on the Continent an automatic "batting out" machine was used. This eliminated a fatiguing task and was also supposed to give a more uniform result. The reason usually assigned for the slight use of the machine in this country was that it was slower than the hand process. The jiggerman would be kept waiting for his bats; consequently his rate of output would be reduced. Irrespective of the merits of the excuse, this was an interesting case of the adoption of a labor-saving device in low-wage foreign countries which was not employed in high-wage America.

The most important new device to be introduced into the ware-

[6] Josiah C. Wedgwood, *Staffordshire Pottery and Its History* (London, 1913), p. 195.

[7] *Crockery and Glass Journal*, October 9, 1879, p. 20; October 6, 1881, p. 26; Geological Survey of Ohio, *Economic Geology*, V (1873), 678.

making department during the nineteenth century was the "automatic pull-down." This tool, still the standard one, consisted of a metal profile attached to a counterpoised arm, so that when it was pulled down it fitted neatly over or inside a revolving mold. The thickness of an article was automatically gauged. Much of the skill demanded by the process it supplanted was rendered unnecessary. At the time the pull-down was first coming into use, a potter commented: "With but little practice unskilled labor can operate this machine, and produce results equal to those for which skilled labor was formerly required. A greater quantity, also, is produced in a given time and at a much less cost. . . . ."[8] The invention was apparently in general use in England by 1875 or before.[9] Yet in Trenton, New Jersey, and East Liverpool, Ohio (the two pottery centers), it was then just beginning to be introduced. As late as 1904 much of the work in Trenton was still being done by the old method.[10]

A later invention, the oval-dish machine, applied the pull-down system to the making of oval as well as round articles. Although this was an American patent, it found very little favor in this country, yet met ready acceptance abroad. In 1912 there were only six such machines in thirty-seven of the leading potteries of the United States.[11] The proof that the method was suited to American conditions lies in its eventual widespread adoption during the World War.

After the ware is formed, and before it can be put into the kiln, it must be dried. To speed up the first part of this drying process when the dishes are still in the molds, resort is had to a heated atmosphere. This is furnished by the so-called "stoveroom." In America this consisted of a heated room with stationary shelves. In England revolving heated compartments were used. The principal advantage of the English stoveroom was the saving in the

[8] U.S. Census of 1880, *Statistics of Wages*, XX (1886), 301, reply to questionnaire made by pottery firm of Knowles, Taylor & Knowles of East Liverpool, Ohio.

[9] *Spon's Cyclopedia of Industrial Arts* (London, 1882), p. 1577; Josiah C. Wedgwood, *op. cit.*, p. 197.

[10] *Fifteenth Annual Report of Commissioner of Labor of the United States: Regulation and Restriction of Output* (1900), p. 688.

[11] *Cost of Production in the Pottery Industry* (1915), "U.S. Bureau of Foreign and Domestic Commerce, Miscellaneous Series," XXI, 107.

time and strength of the mold-runners (youths who carried the newly formed ware into, and the partially dried ware out of, the stoverooms). It lessened the distance traveled, and it did away with the continual running in and out of the moist and superheated atmosphere of the drying compartments.[12]

This had its practical as well as its humanitarian advantages. Mold-runners in the United States were given to frequent and unpredictable absences from work, causing an interruption in the routine of the whole clay-working department. When we remember that these boys would sometimes travel fifteen miles a day and carry a total of thirty-five thousand pounds of ware into and out of a hot drying-room, it is not reasonable to believe that their irregularity was due entirely to laziness.[13] England began to substitute the revolving for the stationary stoverooms as early as 1876. American potteries forty years later began to be convinced of their merits, and a movement to instal some revolving rooms got under way by the outbreak of the World War.[14]

Firing the ware.—The firing of ware in the kiln is the crucial process in pottery manufacture. The expense involved in all the previous processes may be wasted by a few hours of careless or incompetent kiln control. For that reason the potter, slow to change any detail of his manufacturing methods, has been most reluctant of all to change his firing practice. A prominent writer on ceramic technology said in 1893 that kilns had changed very little in the previous fifty years.[15] In 1914 the same statement could have been made. An investigation just before the World War, covering the leading potteries of this country, disclosed that about 50 per cent of the total number of kilns had been built fifteen years or longer, that 13 per cent had been built for twenty-eight years or longer, and that 5 per cent were thirty-five years old or older.[16] Since many or most of the newer kilns listed by the investigation resulted from the construction of new potteries or additions to the capacity of old ones to keep pace with the growth

[12] American Ceramic Society, *Transactions* XVI, (1914), 418.

[13] *Cost of Production in the Pottery Industry*, p. 324. [14] *Ibid.*, p. 119.

[15] E. A. Barber, *The Pottery and Porcelain of the United States* (New York, 1913), p. 10.

[16] *Cost of Production in the Pottery Industry*, p. 113.

of the industry, it is apparent that few kilns were deliberately torn down and replaced. There were no terrors of obsolescence for a pottery kiln. It is only fair to remark, however, that English kilns probably attained even greater ages, and that English firing methods in general were fully as conservative. The innovations in firing principles came usually from Continental countries, particularly Germany.[17]

The chief problem facing the kiln fireman was to determine the heat that was being generated inside the kiln. To ascertain this fact he had only the crudest methods, such as withdrawing test pieces of clay previously placed within reach of a peephole in the kiln wall, and inspecting the fire with the naked eye to determine its intensity by its color. In the eighties the famous German ceramist, H. A. Seger, invented the test cones which took his name. These were merely small bits of clay arranged in a set so that their respective melting-points formed a regular series. The temperature of the kiln, and to some extent the duration of the heat, caused the cones to droop and finally bend double. Thus, if the fireman looked through the peephole and observed that the first cone in the series was down and the second one drooping, he would have a fairly accurate idea of the stage in firing he had reached.

The Seger cones were in general use in Germany in a relatively short time after their invention. In the United States, on the contrary, they were little used even by the end of the nineteenth century. Between 1900 and 1914, however, they were introduced into practically all potteries.[18]

A statement made in 1895 by a member of the Committee on Kilns and Fuels of the United States Potters' Association will serve to summarize the indictment against American firing methods.

> Since the beginning of the pottery industry in this country there has been little improvement in the method of firing kilns and as little improvement in the economy of the operations—almost all of the Eastern manufacturers are burning the best quality of anthracite coal in the same manner and in kilns of practically the same construction as were used twenty-five years ago when slip was sieved by hand and evaporated on slip kilns.[19]

[17] Alfred Searles, *Clay Workers Handbook* (London, 1911), p. 173; C. F. Binns, *Ceramic Technology* (New York, 1898), pp. 56 ff.

[18] American Ceramic Society, *Transactions*, XII (1910), 60; I, 25 and 29.

[19] *Annual Proceedings of United States Potters' Association* (1895), p. 35.

Glazing the ware.—The preparation of a glaze mixture involves the fusing-together of certain of the ingredients into a glassy-like substance called "frit." In the United States this fusing was done in ordinary saggers (fire-clay boxes in which dishes are placed before they are set in the kilns) and during the regular firing. When the saggers were removed from the kiln they had to be destroyed in order to separate them from the frit. This method was expensive in its destruction of saggers, and unsatisfactory because the duration of the firing period was too long for the frit.[20]

Frit kilns were used extensively in England before the end of the nineteenth century. These were small brick structures designed especially for the purpose. They operated continuously, permitting the molten frit to be drawn off from time to time, and they did not involve the use of saggers. A potter of Beaver Falls, Pennsylvania, made experiments in his own plant and estimated that the cost by the sagger method was three and seven-tenths times as great as by the use of frit kilns.[21]

Another part of the glazing process in which English and American methods differed was in the use of the dipping mangle. The large potteries of England used it during the latter part of the nineteenth century. American potters did not use it at all until after 1912.[22] The device consisted of a tall, narrow, heated compartment through which an endless chain carried the newly dipped ware. By this method the glaze dried so rapidly that it was not necessary to touch the dishes while they were wet.

Sagger-making.—An important process supplementary to the actual manufacturing of pottery is sagger-making. All the articles fired in bisque or glost kilns are protected from the smoke and fumes by being incased in these fire-clay boxes. The mortality among saggers through breakage has always been high. In 1900 it was often as much as 8 or 10 per cent every time a kiln was fired.[23] The cost of making saggers was considerable. Their rough and sturdy character would seem to suit them to manufacture

[20] *Cost of Production in the Pottery Industry*, p. 145; C. F. Binns, *op. cit.*, p. 65.

[21] American Ceramic Society, *Transactions* IX (1907), 195–200.

[22] *Cost of Production in the Pottery Industry*, pp. 167 and 120.

[23] American Ceramic Society, *Transactions*, III (1901), 27; *Journal*, IV (1922), 398.

by automatic machinery, but they were not so made. It was not until about 1914 that sagger-making machines were installed in American tableware potteries. Foreign potteries, especially Continental ones, had used machines long before, as had also other branches of the American clay-products industry.[24]

The foregoing are some outstanding cases of the laggardness of American pottery managers in adopting new devices and methods. In almost every case the merit of the innovation was proved by its final adoption. As another method of approach to the question of the relative competence of American and foreign pottery managers, we can take evidence on their general training, attitudes, and habits of mind.

One of the most noticeable characteristics of the American pottery industry during the first half-century of its existence was the English stamp it bore. Many of the workmen and a good proportion of the managers during the nineteenth century were of English birth and training. In 1880, 1,056 of a total of 7,233 workers had been born in Great Britain. If most of these were skilled workmen, as contemporary comment would lead us to believe, we can understand the dominance of the English tradition.[25] The two pottery towns of Trenton, New Jersey, and East Liverpool, Ohio, seem a bit English in appearance and layout even today. They must have been quite English, say in 1880, when Trenton boasted a cricket club.[26]

If one country imitates another and mans its industry with workmen and managers emigrant from the latter, it is not likely to rise above a second-rate position. American potteries occupied such a position during the nineteenth century. Only during the present century has our industry begun to take on a native vigor. In the process of transplanting English processes and attitudes in American industrial soil, the undesirable features seemed to take root more vigorously than the desirable ones. For example,

[24] American Ceramic Society, *Transactions*, V (1903), 375; XI (1909), 220 and 226; *Cost of Production in the Pottery Industry*, p. 697.

[25] *Crockery and Glass Journal*, April 22, 1880, p. 26; October 30, 1879, p. 24; June 17, 1880, p. 24; June 20, 1879, p. 19; August 26, 1896, p. 19; *Census of Population for 1880*, p. 750.

[26] *Crockery and Glass Journal*, April 18, 1880, p. 20.

American potteries surrounded themselves, their processes, and particularly their formulas with an air of mystery that was in direct line with the English tradition. Medieval alchemists were hardly more careful to guard their secrets than were American potters of the eighties. A little booklet written for and published by a Trenton pottery in 1886 commented in its Introduction: "It is a rare thing for anyone to get an opportunity to go through all parts of a pottery."[27]

At the second yearly meeting of the American Ceramic Society it was announced that many technical men in the industry were forbidden by their employers to attend the meeting, for fear they would inadvertently give away trade secrets. At the same meeting, which was held just at the turn of the century, the president of the Society lamented: "It is only too true that we have transplanted the inherited secrets and family monopolies of the English potter and the art is suffering severely today from the bias and barriers that circumscribe . . . . [it]."[28] The locked and automatic weighing scales, which prevented anyone in the plant but the holder of the sacred formula from knowing the weights of the different clays that went into a body or glaze mixture, were familiar features of the potteries.

As a result of the tradition of secrecy, each potter was limited to such knowledge as he could derive from his own research. The amount of such research was, of course, negligible. Moreover, when ceramic research began to be put on an organized and cooperative basis, mainly through the efforts of the other branches of the clay-products industry and through the agency of the American Ceramic Society and the ceramic departments of the universities, the tableware potters would have none of it. Early in the century, schools of ceramics began to turn out graduates. These men readily found places in clay-products plants of all kinds except the whiteware potteries. The average pottery superintendent regarded them with scorn and suspicion.[29]

[27] W. S. Harris, *The Potter's Wheel and How It Goes Around in the 19th Century* (Trenton, N.J., 1886), p. 160.

[28] American Ceramic Society, *Transactions*, II (1900), 19.

[29] *Ibid.*, VIII (1906), 36 and 40; XII (1910), 611 and 620.

In 1912 the agents of the Bureau of Foreign and Domestic Commerce surveyed the pottery industry in this country and abroad and concluded: "One of the factors prejudicial to the best development of the American industry has been the ultra-conservative attitude of the manufacturers toward technologic information and assistance, in contrast to the receptiveness of other leading American industries."[30]

As a summary characterization of American pottery technology between 1860 and 1914, it seems fair to say that the industry was inefficient and slow to improve. English potters, themselves conservative, were often decades ahead of American potters in the adoption of better methods. In their distrustful attitude toward ceramic research, and in their medieval secretiveness and traditionalism, our potters equaled or outdid the parent-industry in England.

COMPARATIVE TECHNOLOGY SINCE 1914

Significant changes have occurred in the technological status of the American pottery industry since 1914. There has been a more rapid forward movement in production methods than in any other period of equal length. This was not due to the invention of new machines and methods so much as to the adoption of processes already used in Europe and in other branches of the clay-working industry. A beginning was made toward closing up the tremendous gap between existing technical information and current pottery practice.

A brief survey of technological changes made since 1914 will suffice to show that genuine progress has been made. The oval-dish machine, which was almost entirely ignored for a long time, came into use rapidly during the early years of the World War and at the present time is used in practically all important American potteries.[31] The oval-dish machines supplanted a slow and expensive process of hand pressing. The story of the passing of the hand presser is told by a comparative census of pottery occupations for 1912 and 1925. In the former year hand pressers still triumphantly pursued their craft in defiance of mechanical ap-

[30] *Cost of Production in the Pottery Industry*, p. 194.

[31] *Monthly Labor Review*, December 1926, pp. 123, 124, 132; letter from Hilmar Mueller of Mueller Machine Co., July, 1927.

pliances. In East Liverpool, Ohio, there were 270 of them (compared to about the same number of jiggermen). In 1925 a survey of the industry found only sixteen pressers and six hundred jiggermen.[32]

But the disappearance of the hand pressers was not due entirely to the oval-dish machine. Another process of forming ware, entirely different from either pressing or jiggering, assumed importance. This was casting. The clay as a liquid mixture is poured into molds. The molds absorb the water, leaving a shell of clay in the desired shape. This method works particularly well for irregular and fragile pieces and for a clay body that is not of sufficient plasticity to behave well on a jiggering machine.

Before the World War casting was employed to a considerable extent in England and to a very wide extent on the Continent, but in America it had little place. In 1912 there were casting equipments in only eight out of thirty-seven potteries. A list of pottery-workers in East Liverpool, Ohio, in 1912 included only 6 casters (as compared to 270 pressers and 290 jiggermen).[33] In a group of English potteries in the same year there were 85 casters as compared to 225 jiggermen and 132 hand pressers.[34] England was obviously using casting to a considerable extent, although she also was slow to relinquish the time-honored pressing method. Similar comparative figures for the Continental potteries, if available, would undoubtedly have shown an even greater preference for casting and a relatively smaller number of pressers. But in the years subsequent to 1912, American potters finally felt the weight of the European example and gradually adopted the casting process. In 1925, in a group of 52 potteries, there were 285 men working at casting, almost as many as there were jiggermen.[35]

[32] *Wages, Hours and Productivity in Pottery Industry* (1926), Bull. 412 of the Bureau of Labor Statistics, p. 15.

[33] *Cost of Production in the Pottery Industry*, p. 437.

[34] *Ibid.*, pp. 353 and 425.

[35] *Wages, Hours and Productivity*, p. 23. The labor union, the National Brotherhood of Operative Potters, must assume some blame for the tardy development of casting in this country. It held up the casting piece-rate so that the economies of labor cost effected by it were not great (*Proceedings of United States Potters' Association* [1914], pp. 36–37).

Equipment for drying the ware after it leaves the hands of the jiggerman, caster, or presser has been modernized along the lines of the possibilities suggested in our previous discussion. American equipment is probably as good now as that of any other pottery-producing country. The dipping mangle for drying the glaze on the newly dipped pottery is in use in practically all large potteries. There is now probably a larger per cent of installations in American than in English potteries.[36] The use of saggers for preparing frit (an ingredient in the glaze mixture) prevailed until recently. Brick frit kilns have come into use gradually, during and since the World War.[37]

Sagger-making machinery has slowly been forcing its way into American tableware potteries. Most large potteries are making part of their saggers with automatic presses, but there are few if any potteries that have entirely given up the handmade sagger. Of the total number of men working at sagger-making, the majority are still hand workers.[38] England is using relatively no more sagger machines than the United States and perhaps not as many.[39]

For a long time the periodic kiln, throwing forth a great volume of waste heat every time it was cooled and emptied of its contents, has been regarded by everyone as a patent source of fuel waste. The obvious remedy for the waste of alternately heating and cooling the kilns was to devise a means of loading and emptying them without allowing the heat to escape. Experiments in the building of continuous kilns were begun as early as the middle of the nineteenth century, and in 1859 a successful one was constructed in Germany. By the end of the century the continuous kilns were well established in Europe, especially in Germany, for coarser types of clay ware and to a small extent for tableware. By 1914 installations had been made for porcelain dinnerware manufacture in Germany, Italy, France, and Belgium, probably six or eight

[36] *Monthly Labor Review*, December 1926, p. 127.

[37] W. A. Koehler, *The Whiteware Industry of West Virginia* (1929), Research Bull. 5 of West Virginia University Engineering Experiment Station (Morgantown, W.Va.), pp. 83 and 89.

[38] *Wages, Hours and Productivity*, pp. 25 and 26.

[39] *Monthly Labor Review*, December 1926, p. 125.

kilns in all. The possibilities of economy are indicated by the fact that a kiln at La Louvière, Belgium, fired tableware for two and one-half years without being cooled off once.[40]

The first kiln of the continuous type to be erected for the firing of high-grade pottery in this country was owned by the General Electric Company. It began operation in 1913, firing porcelain electrical fixtures. A few estimates made by the operators of this kiln will serve to illustrate the possibilities of economy in the continuous process. The fuel consumed per volume of ware was about one-half as great as under the periodic firing process. The cost of labor for handling saggers was about 10 per cent less. The average life of saggers increased by one-sixth.[41]

It is difficult to see how the American potters resisted so long the lure of these savings, but until very recently they have presented a united front against the temptation. Even today only a few tableware potteries use continuous kilns, although the rate of installation has greatly increased within the last five years. The bulk of the American output still comes from the old periodic kilns, similar to the ones in which the first white tableware was fired in this country.

Why has the continuous firing process been so slow to gain entrance? There are several reasons: (1) The cost of building continuous (or tunnel) kilns is great compared to the outlay for a periodic kiln. The increase in capacity is, however, more than in proportion to the increase in cost. (2) The large capacity of the tunnel kiln robs it of flexibility and makes it unfit for a small pottery with a fluctuating output. The potential savings will go unrealized if the kiln is not kept constantly in operation. (3) Changes in firing methods are necessary. Most potters are without the advice of scientifically trained men, and even were it available, would distrust it. Consequently, most of them have been unwilling to undertake the necessary experimentation and risk involved in changing methods—risks which their rule-of-thumb attitude toward technical problems magnifies. (4) Finally, we must again comment that there seems to be strong evidence of

[40] American Ceramic Society, *Transactions*, III (1901), 205; VI (1904), 207; XVIII (1916), 109.

[41] *Ibid.*, XVIII (1916), 109.

technological laggardness, in the absence of which the foregoing difficulties would have been overcome long since. In this case, while other countries have pointed the way to change, they have done no more toward realizing it than has the United States.[42]

Certain factors in the success of a pottery cannot be reduced to statements of the amount and type of mechanical equipment. Of two plants with about the same equipment, one may have twice the losses from imperfect ware that the other has. One may produce a vastly superior type and quality of ware. One plant may produce a vastly superior type and quality of ware. One plant may be able to change the character of its ware readily to meet new demands, while the other may flounder for a long time over a slight change. These are matters that require a good understanding of the chemistry and physics of pottery, practical experience with pottery problems, and constant experimentation, checking, and testing; for want of a better name we may call what is required "laboratory control," to indicate both the existence of a testing laboratory and the presence of scientific habits of mind.

Our potters are less advanced in respect to laboratory control than in the use of mechanical appliances. A close connection between research men, or "theoretical men" as the potters are fond of calling them, and the pottery managers has been hard to establish. The three great agencies of ceramic research, the American Ceramic Society, the college departments of ceramics, and the governmental research bureaus, notably the Bureau of Standards and the Geological Survey, have not had the hearing they deserve.

Edward Orton, Jr., a pioneer in the field of ceramic education, is pessimistic about the technical progress of the pottery industry and is scathing in his indictment of its smug and skeptical attitude toward technical training.

> Potters assume that they represent the top story of the clay industry. It is this idea of self-sufficiency and superiority which has made the whiteware potter the least progressive instead of the most advanced of the clay industry. . . . . I see in the pottery industry many glaring wastes going on decade

[42] Continental chinaware potteries employ periodic kilns but use a three-deck arrangement. By firing ware in different stages of completion in the different decks, they realize fuel economies, but not as extensive ones as are attainable by tunnel kilns.

after decade with no effort to check or improve them. I fear that those in charge cannot or will not become leaders in bringing the industry to a higher plane of efficiency.[41]

Other students and technicians are not so harsh in their judgments as Orton, but they agree that laboratory control is only in its weak beginnings, and that only a few of our potteries have anything worthy to be called by that name. The prevailing opinion is that laboratory control is more widely used in Germany, and, perhaps in Austria and France, than in the United States. On the other hand, England is doing less in this respect than this country.

In concluding our survey of technology since 1914, we may say that the pottery industry of the United States has made considerable progress—particularly in installing new machines and adopting new mechanical methods. There remains much to be done by way of improvement and more widespread installation. In tunnel-kiln development our potters have done as much within the last ten or fifteen years as anyone, though the fact remains that they initiated nothing and have been dragged in the wake of the progress of the other branches of the American clay-products industry.

When we consider such matters as the development of an objective and scientific attitude and the employment of laboratory control, the record of the last decade and a half does not read well. Most potteries are still operated by rule of thumb in an industry which severely penalizes such methods. While other branches of the ceramic industry have hired technically trained men and have co-operated with research institutions, most of the potters have held aloof. Tradition and skilled guesswork still hold sway in a large part of the industry.

A reasonable forecast of the development of the pottery industry during the next decade would read something like the following. There will be fewer and larger plants. Along with this change, and partly because of it, there will be great improvements in the direction of higher quality and lower cost. The small pottery appears to be doomed—doomed by the inefficiency of its managers and by the new methods of production which cannot

[41] *New Jersey Ceramist*, I (1921), 12–13.

economically be adapted to the small concern. The continuous kiln will be one of the chief instrumentalities of change. Its influence will be twofold: (1) By its economies it will help to eliminate the small plants that cannot fit their small and fluctuating outputs to it. (2) By its continuous operation it will encourage a reorganization of many other steps of production in such a manner as to achieve a smooth flow of production through the entire process.

With this set of influences at work it is safe to predict that the pottery of the future will present a very different appearance from the pottery of the present. The irregularly shaped, two- or three-storied brick buildings with kiln chimneys sticking up here and there, with clay dust whitening the narrow windows, and with a heap of broken saggers in the background will be replaced (as they have been already in a few instances) with large, low, steel-braced structures. Most of the picturesque processes of manufacture and the medieval managerial attitudes will not survive the change of quarters.

GENERAL CONCLUSION

Looking back over the seventy years of pottery history since the Civil War first stimulated the manufacture of whiteware for table use, we see a rate of technical progress that cannot be regarded as satisfactory. It was particularly unsatisfactory between 1860 and 1914. By any standard of comparison this was true—comparing our potters with foreign potters; comparing our tableware potters with potters in other American branches of clay-working such as electrical porcelain; comparing our pottery achievements with the standards of technology which students of ceramics regarded as reasonable. We shall not attempt at this time to assign a reason for this retardation except to comment that the high level of tariff protection which has always been accorded the industry may have had a bearing on the situation. If the advocates of tariff protection for infant industries were searching for a good supporting case for their arguments, they would be unlikely to choose this one.

H. J. STRATTON

ILLINOIS COLLEGE

THE ECONOMIC SIGNIFICANCE OF BROKERS' LOANS

THE Federal Reserve Board is often criticized for its failure to prevent the wholesale "diversion" of bank credit into speculative markets in 1928 and 1929. It is believed that bank funds used in this manner cause a scarcity of credit for legitimate business purposes. All criticism of this type is based upon a theory that the total of brokers' loans represents the amount of credit absorbed in speculation. Adherents to the theory are acquainted with the daily-settlement plan of the New York Stock Exchange, which requires that its members settle their obligations by 2:15 P.M. of the first full business day that follows the date of the contract. They also know that a large portion of the stock-exchange transactions are executed for the accounts of marginal traders. Consequently they conclude that brokers' loans are the result of brokers borrowing the difference between their customers' margins and the cost of the securities which they purchase, and that brokers will need to borrow increasingly larger sums to carry marginal purchases as the market becomes more active and the stock prices rise. Those who adhere to this theory, however, have failed to consider the workings of the various mechanisms and devices employed by the members of the New York Stock Exchange.

In actual practice brokers pay the Stock Clearing Corporation for the securities which they purchase and receive payment from it for the securities which they sell. Hence each individual broker only needs an amount of funds equal to the excess of his purchases over his sales. On many days, of course, his sales exceed his purchases, and on such days he needs no funds at all. The purchases and sales on January 7, 1932, of six members of the New York Stock Exchange are listed in Table I. Four of the brokers did not pay out any funds on this day, although their combined purchases of stocks amounted to more than four and a half million dollars. It is evident, therefore, that brokers do not find it necessary to borrow the difference between their customers' margins

and the cost of the securities which they purchase in order to effect a daily settlement of their transactions among themselves.

TABLE I

PURCHASES AND SALES OF SIX MEMBERS OF THE NEW YORK STOCK EXCHANGE ON JANUARY 7, 1932*

FIRM	PURCHASES		SALES		FUNDS REQUIRED FOR SETTLEMENT
	Shares	Value	Shares	Value	
A	32,100	$1,091,365	37,100	$1,450,312	.....
B	20,200	537,081	13,700	413,412	$123,669
C	12,700	677,112	15,200	785,675	.....
D	44,000	1,706,962	66,200	2,010,732	.....
E	36,800	1,179,046	39,400	1,207,350	.....
F	28,900	1,170,312	31,000	988,600	181,712

* These statistics were furnished by the New York Stock Clearing Corporation and include transactions in cleared securities only. However, since transactions in cleared securities average over 90 per cent of all transactions, the figures may be accepted as representative.

TABLE II

PURCHASES AND SALES OF A MEMBER OF THE NEW YORK STOCK EXCHANGE, JANUARY 7 TO 22, 1932*

	PURCHASES	SALES	EXCESS PURCHASES	
			Amount	Per Cent
Jan. 7	$1,091,365	$1,450,212	−$358,847	.....
8	1,066,444	1,441,950	− 375,506	.....
11	2,167,012	1,755,200	411,812	18.9
12	1,229,743	1,053,137	176,606	14.3
13	1,096,638	1,054,436	42,202	3.9
14	1,069,947	1,784,061	− 714,114	.....
15	2,353,542	1,866,155	487,387	20.7
18	1,519,609	1,562,537	− 42,928	.....
19	1,471,066	869,800	601,266	40.7
20	724,538	697,881	26,657	3.5
21	677,731	958,934	− 281,203	.....
22	1,070,531	1,078,729	− 8,198	.....
Total	15,538,166	15,573,032	− 34,866	.....
Average	1,170,178	1,173,934	− 3,756	.....

* Stock Clearing Corporation statistics for cleared securities only. The average was computed after the sales reported for the Fridays, January 8th, 15th and 22d, had been pro-rated between Friday and Saturday on the basis of the total volume of sales reported for these days and after the figures for the Saturdays were omitted.

In Table II the daily purchases and sales of an individual broker for a period of two weeks illustrate the tendency of adverse clearing-house balances to be canceled out every few days by favorable

balances. Thus, though the balances varied from an adverse one of $604,000 to a favorable one of $714,000, the net balance for the whole period was less than three-tenths of one per cent of the total purchases or sales. It follows, therefore, that the maximum borrowings of a single broker over a period of time are not greatly affected by his adverse clearing-house balances. With one exception none of the adverse balances in either Table I or Table II amounted to more than 25 per cent of the total purchases for that day. On October 30, 1929, when the volume of trading was the largest in the history of the Exchange, the ratio of total cash required for settlement purposes to the total value of all contracts executed (one side only) was 19 per cent.[1]

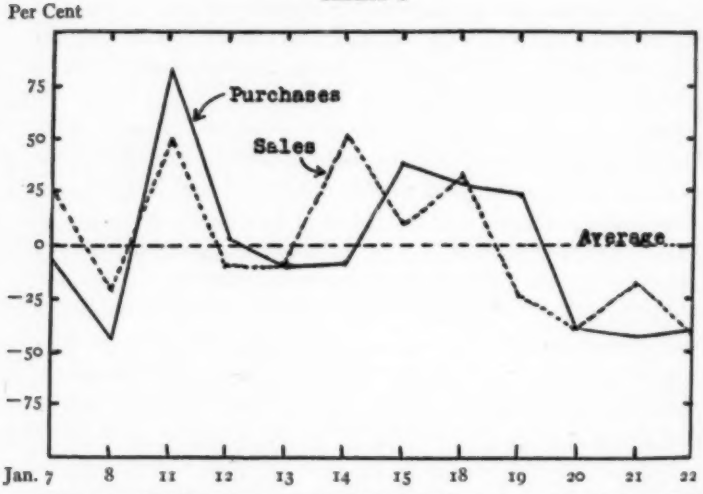
Since a broker's need of bank credit for settlement purposes is contingent upon the amount by which his purchases exceed his sales and not upon the total volume of business that he transacts, an increase in market activity does not necessarily imply an increased demand for loans. The actual purchases given in Table II varied during the period from 83 per cent above to 44 per cent below the average daily purchases, and the actual sales varied from 52 per cent above to 40 per cent below the average daily sales. The curves shown on the accompanying graph indicate the extent to which purchases above average were accompanied by sales above average, and purchases below average by sales below average. A high correlation of the two curves is, of course, to be expected, since an increase in the total volume of purchases on the Exchange necessarily implies an equal increase in the total volume of sales, with a high probability that any individual broker who received his proper share of the increased number of "buy" orders would likewise receive his share of the increase in "sell" orders.

The total value of the contracts executed on the floor of the Exchange on October 30, 1929, was $866,679,782.66. After the Stock Clearing Corporation had effected cancellation of each broker's sales against his purchases, it was found that one set of brokers (those whose sales exceeded their purchases) were creditors of the clearing house to the extent of $167,101,200, and that

[1] Statistics secured from the Stock Clearing Corporation.

another set of brokers (those whose purchases exceeded their sales) were indebted to the clearing house for a like total. Settlement was effected through the writing of 830 checks. The question then arises as to what the creditor brokers did with the $167,101,200 which they had coming from the clearing house. Of this total, $146,684,088.01 was never paid to the creditor brokers but was paid by the Stock Clearing Corporation to banks to re-

CHART I



Per cent deviation from average of the purchases and sales of a New York Stock Exchange member, January 7 to 22, 1932.

duce the indebtedness of these brokers. Since brokers do not always pay off their loans through the clearing house, a large portion of the $20,417,111.99 balance that was paid directly to brokers was probably also used to reduce indebtedness.[2] At any rate, a large part, if not all, of the funds borrowed by brokers to meet adverse clearing-house balances are used by the brokers who have favorable clearing-house balances to reduce indebtedness. It follows, therefore, that the total of brokers' loans is not materially affected by the volume of purchases and sales of stocks.

[2] Statistics secured from the Stock Clearing Corporation.

It is claimed by some writers that brokers' loans are increased when an outright owner sells stocks from his strong box to a marginal trader.[3] This is true, however, only when the outright owner withdraws his funds, and then brokers' loans are increased as a result of the withdrawal and not because of the marginal purchase. Suppose, for example, that fifty outright owners each deposit 100 shares of stocks with a broker and order him to sell the stock at a price which averages $90 *but do not withdraw the proceeds*. Suppose, also, that fifty customers of the broker each order the broker to purchase 100 shares of this stock at prices which average $90, but only deposit 10 per cent of the purchase price as margin. The broker's clearing-house blotter for the day would show the following:

Amount due to the Clearing House because of stock purchases	$450,000.00
Amount due from the Clearing House because of stock sales	450,000.00
Amount of cash required by broker	$000,000.00

Although in this example outright owners sold stock taken from their strong boxes to traders who bought on extremely thin margins, the broker was able, nevertheless, to reduce his indebtedness by an amount equal to 100 per cent of the deposits of the marginal purchasers, instead of being forced to borrow. The amount of funds which a broker requires for clearing-house purposes is thus dependent upon the excess of purchases over sales and not upon the margins maintained by customers. It might be urged that sellers of stock do not, as a rule, leave the proceeds of their sales with brokers. Whether they do or do not, however, depends upon the motive for their selling. In a rapidly rising market, such as existed in 1929, a great deal of selling is for the purpose of disposing of stock "A" to buy stock "B," in which case the funds are not withdrawn from the market by the sellers. And, as long as there remains a probability of stock prices rising higher, a general exodus of investors and speculators from the market is

[3] Cf. H. L. Haney, *Brokers' Loans* (Harpers, 1932), p. 17. "We may say, then, that an increase in loans to brokers ordinarily arises when marginal traders purchase stock from sellers who own outright."

not apt to take place. To the extent, however, that withdrawals of funds follow the selling of securities by outright owners, brokers' loans will tend to rise.

But this withdrawal of funds need not be made by an outright owner, for a withdrawal of funds by an "ex-marginal" holder of stocks will also increase brokers' loans. Assume, for example, that a speculator purchases a block of stock worth $10,000 on a 40 per cent margin. If the market value of this stock rises to $40,000 and if the speculator disposes of it at this price, he would have a credit balance of $36,000 in his account. If the person to whom the stock was sold was also trading on a 40 per cent margin, this person would have to deposit $16,000 with a broker. Thus the seller would have a legal right to withdraw $36,000 from the market although the purchaser only deposited $16,000. As long as the seller does not withdraw his funds the broker will not need to borrow, but should the seller decide to withdraw the broker will find it necessary to borrow. Thus brokers' loans are increased whenever one speculator withdraws more funds from the market than are deposited by the speculator that takes his place.[4]

Ordinarily, the daily deposits and withdrawals of customers balance, so that brokers find it necessary to keep but a small amount of cash on hand to meet withdrawals of customers. Occasionally, however, after the prices of stocks have had such a prolonged rise as to encourage profit taking, customers' withdrawals will exceed their deposits. This excess of withdrawals over deposits may continue if prices display indications of further declines and will make it necessary for brokers to increase their borrowings. A net withdrawal of funds from the market by traders indicates a reduced active demand for stocks. This, of course, makes lower prices necessary to attract purchasers, and may so alarm the remaining traders as to cause them to dump their securities on the market and to withdraw their funds also. If this happens, prices will decline lower and lower and brokers' loans will rise higher and higher, until the bargain prices of stocks attract new investors to the market or make it necessary for old

[4] For a complete account of the various factors which affect the total of brokers' loans see my article in the *American Economic Review* (March, 1932) on "The Economics of Brokers' Loans."

traders whose margins have become impaired to deposit additional funds so as not to be sold out at the low prices. Only as the inflow of funds from these two sources becomes larger than the payments made to withdrawing traders will it be possible for brokers to reduce their indebtedness.

Something of this nature took place in the fall of 1929. Stock prices as measured by the Dow Jones Industrial Averages reached their peak on September 3, and then began to drift slowly but steadily downward as cautious traders withdrew from the market. Brokers' loans, however, continued to increase for six weeks after the decline in prices started. On October 30 the effect of the accumulated withdrawals precipitated a drastic and violent readjustment of prices. When this occurred traders rushed to purchase stocks at what then seemed to be bargain prices. At the same time calls of brokers for more margins brought a flow of funds into the market from traders who had not closed out their accounts before the crash. As a result, the total of brokers' loans declined by almost two billion dollars in two weeks.

The combined borrowings of New York Stock Exchange members reached a total of $8,549,000,000 in 1929.[5] This means that the withdrawals of funds from brokers had exceeded the deposits with them by this amount and that brokers had been forced to rely on bank borrowings to meet the excess withdrawals of their customers. The banks had been willing to loan funds because the loans were secured by valuable collateral and because speculators promised to return the funds upon the call of the banks. Hence, this eight billion dollars of brokers' loans represented funds withdrawn from speculation for use elsewhere and not funds absorbed in speculation at the expense of legitimate business.

But profit-taking traders were not responsible for all of the withdrawals which took place, for a large portion of the funds withdrawn went into the coffers of the corporations that were floating new stock issues. These flotations had somewhat the same effect upon the total of brokers' loans as the selling by outright owners of securities taken from deposit boxes would have had, except that outright owners sometimes leave the proceeds of the sale with the broker, whereas the corporations withdrew their

[5] As reported by the New York Stock Exchange, September 30, 1929.

funds for use outside the stock market or to reloan at call in the money market. In the latter case the returning of the funds to the market as loans augmented the supply of funds to the same extent that the withdrawal increased the demand for funds. But the new issues need not be bought by marginal traders in order that the total of brokers' loans be affected, since, if the new flotations diverted to corporations any of the funds which otherwise would have been deposited with brokers without at the same time reducing the withdrawals of profit-taking traders, the total of brokers' loans must have been increased by the amount of that diversion.

In 1929 many persons who had purchased stocks on margins were making monthly payments to brokers to increase their margins. Suppose that such a marginal holder of twenty shares of the common stock of the United States Steel Corporation was paying $135 a month of his salary to his broker, at the time that this company offered its stockholders the right to purchase one new share of stock at $140 for each seven shares already owned. The execution of this right by the foregoing investor must have diverted his next three months' payments to the corporation, since his payments to the broker were not obligatory as long as the proper margin was maintained. It is also quite likely that some recipients of these rights to buy stock would find it desirable to sell stocks of other companies which they were holding, withdraw the proceeds of the sales from their brokers, and execute their rights to purchase additional shares of United States Steel stock. If so, this new flotation of stock by the United States Steel Corporation not only diverted the flow of funds from customers to brokers but actually increased the flow of funds from brokers to customers and hence caused the total of brokers' loans to increase even though the new stock was not purchased by marginal traders.

Fortunately, the New York Stock Exchange has collected statistics of the amounts of actual cash received by corporations listed on the Exchange from their financing through the issuance of stock "rights." This financing tended to augment brokers' loans, since, as was demonstrated above, it diverted the flow of funds from customers to brokers and in some cases actually in-

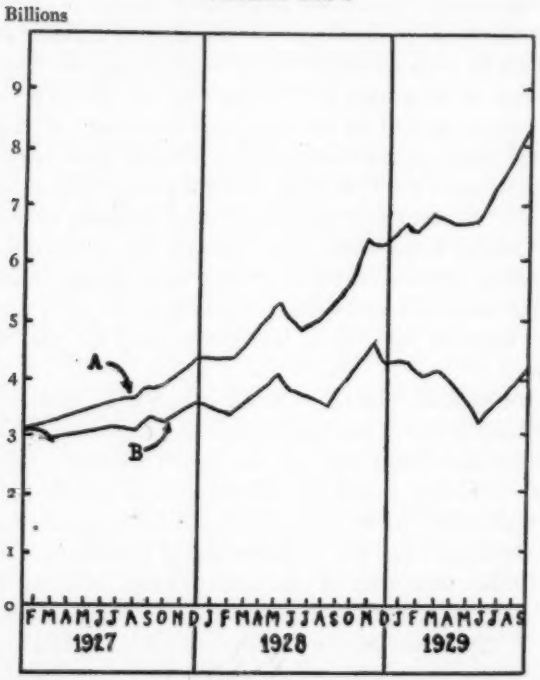
creased the amount of customers' withdrawals. The funds taken from investors and speculators in this manner were either not returned to the market by the corporations, or were returned as loans, in which case their return did not reduce brokers' borrowings. If the monthly statistics of "rights" financing are accumulated from the beginning of 1927, the date when they began to assume significant proportions, to the stock-market crash of 1929, the total at any given date indicates the amount of funds secured to that date by corporations listed on the Exchange and represents the amount of borrowing by members of the New York Stock Exchange necessitated by the corporate financing. If these accumulated totals are then substracted from the total borrowings of the members of the New York Stock Exchange, the remaining totals (line "B" on Chart II) give a rough estimate of what the total of brokers' loans would have been had the purchasing of the new issues not diverted the flow of funds from brokers to corporations. The total of brokers' loans would have declined from November, 1928, to July, 1929, had it not been for the "rights" financing.

The issuance of "rights" reached its peak in June, 1929, in which month $816,674,000 was secured by corporations from persons who owned stocks listed on the New York Stock Exchange. "Rights" financing during the following three months was relatively small. The rise in the total of brokers' loans during these months resulted from the withdrawals of speculators for some purpose other than that of purchasing stocks listed on the Exchange. The fact that the flotations of new stock issues as reported by the *Financial and Commercial Chronicle* and Standard Statistics were large during July and August and reached their peak in September would suggest that the withdrawals of traders at this time may have been made for purposes of purchasing stocks not listed on the New York Stock Exchange. In order to purchase these stocks, traders not only lessened their sending of additional funds to brokers, but began to sell the stocks they held and to withdraw the proceeds. This selling was probably accentuated by the extremely high level which stock prices had attained in August. At any rate, the total of brokers' loans would not have mounted as rapidly as it did had traders not chosen to

withdraw their funds for use elsewhere. The only way in which the Federal Reserve Board could have stopped the rapid rise of brokers' loans in 1929 would have been to stop the new financing of corporations. These huge flotations were in reality diverting

CHART II

BROKERS' LOANS



A, monthly totals as reported by the New York Stock Exchange; B, monthly totals with effect of "rights" financing eliminated.

bank credit from its legitimate channel of financing the distribution of commodities into investment in more or less permanent factory equipment.

The analysis thus far has concerned itself only with the forces responsible for the demand for loans and has not dealt with the origin or source of the funds borrowed. It cannot be denied, of

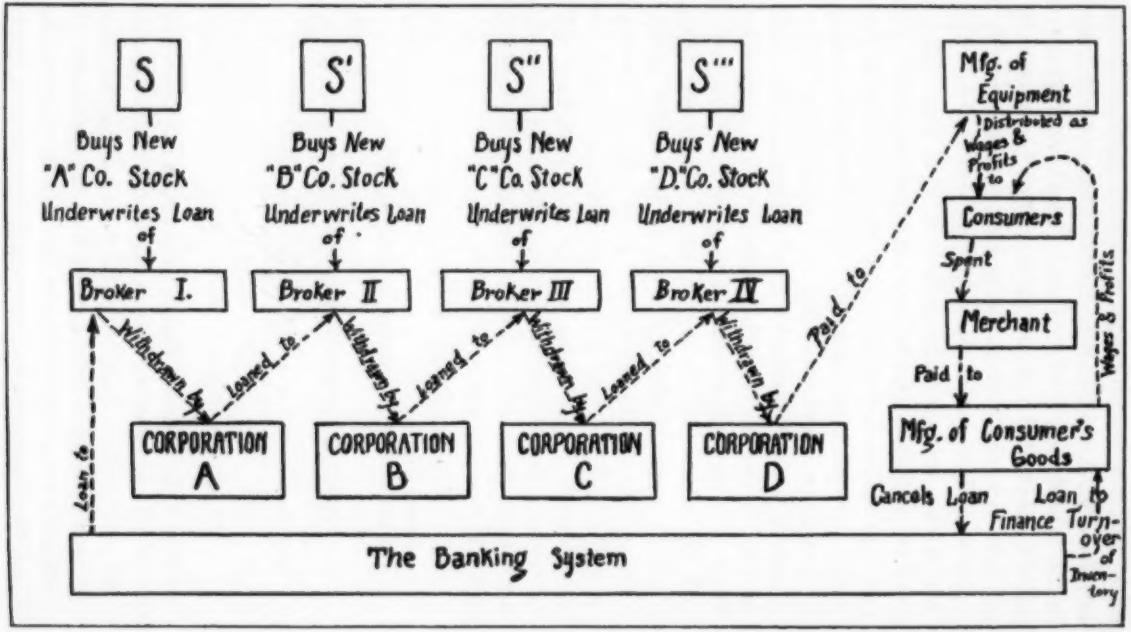
course, that a large part of the funds were supplied by corporations, nor that the corporations secured some of these funds from the sale of their new stocks. Thus, a New York bank may have loaned a million-dollar deposit account to a broker who in turn used it to meet the withdrawals of his customers made in order to purchase the new stocks issued by corporation "A." This corporation, not having an immediate need of funds, may have loaned the million dollars in the money market at call, with the result that the funds were then used by some trader to purchase the new stock of corporation "B." In a like manner corporation "B" may have passed the money on to corporation "C," who in turn passed it on to corporation "D." Eventually the deposit account will have come into the possession of a corporation that will use it to buy new productive equipment. When this occurs, the funds will be paid to the producers of the new productive equipment and expended by them for consumers' goods. The merchant who sells the consumers' goods may use the money to pay off the bank loan that financed the turnover of his inventory. Thus the credit which originated in a New York bank will have been returned to the banking system. This circuit flow of funds is illustrated in Chart III. After the completion of the circuit, the credit situation will stand as follows.

The New York bank has the right to call upon Broker I for	$1,000,000
Corporation "A" has the right to call upon Broker II for	1,000,000
Corporation "B" has the right to call upon Broker III for	1,000,000
Corporation "C" has the right to call upon Broker IV for	1,000,000
Total loans subject to call	$4,000,000

Brokers I, II, III, and IV have a right to call upon their customers for $4,000,000. As long as stocks maintain high exchange values, there will be little danger of these loans being called, but if prices should move downward at least the loans made by the corporations are quite apt to be called. If this happens, brokers will call upon their customers to deposit more margin. Since there

CHART III

ILLUSTRATING SOURCE OF "LOANS FOR OTHERS"



is a limit to the amount of funds that speculators can immediately take from their current incomes and deposit with brokers, banks will find it desirable in order to avoid too violent a readjustment of prices to substitute bank credit for a portion of the credit withdrawn by the corporations. Hence, whether the funds were originally loaned by corporations or by banks, the ultimate effect is the same as if only bank credit had been used. In the fall of 1929, when the stock-market crash occurred, speculators sent huge sums to New York to bolster their weakened accounts and New York banks substituted a billion dollars' worth of bank credit for the funds withdrawn by corporations and out-of-town banks.

If it can be assumed that the purchasing power which would have existed in the years 1927, 1928, and 1929 would have been sufficient to purchase the goods produced in those years if there had been no stock-market boom, then the addition of eight billion dollars or more of bank deposits to the existing supply of purchasing power must have made that supply more than sufficient to purchase the goods produced during those years and have caused some degree of inflation to exist. These bank deposits, although loaned to brokers, eventually reached the hands of corporations and consumers. They were used by the former to purchase additional productive equipment and by the latter to purchase consumers' goods. It would hardly have been considered proper for banks to finance either of these transactions directly. Yet the mere interjection of a middleman between the source and the ultimate use of the funds is scarcely enough to legitimatize that which otherwise would have been improper.

Whether or not inflation actually existed before the stock-market crash, it is a fact that in the two years that followed the total of brokers' loans was reduced eight billion dollars. This reduction of outstanding loans must necessarily have been achieved through the flow of a portion of the bank deposits representing current income into the banks to cancel loans, since the only other alternative is that the corporations and individuals who had secured title to the bank deposits originally loaned to brokers would donate them to the speculators who stood pledged to pay off the loans. If the deposits were paid out to the speculators in the form

of wages and used by the latter to liquidate loans, then there would remain insufficient bank deposits to purchase the goods which the wage-earners had produced. Hence, it has been necessary for corporations to sell a large part of the goods produced since 1929 at a loss, because a part of the current income which the production of the goods created went to reduce bank credit, with the result that the balance left to purchase the goods was less than their economic cost of production. Faced by continually shrinking values, producers stopped producing and current income became less. Nevertheless, the flow of funds to the bank to cancel debts continued, so that the relative proportion of the total income being used for this purpose became greater as the income itself became less and prices had to decline still farther in order to move goods off of the shelves.

The great amount of bank deposits loaned to brokers in 1928 and 1929 and paid by them to corporations and traders augmented the amount of consumers' purchasing power in existence without at the same time materially increasing the amount of consumers' goods. The economic effect of the liquidation of these loans in 1930 and 1931 was to reduce the amount of current income that could be used to purchase current production. Thus the flow of bank credit through the speculative markets into the possession of corporations and speculators and the return flow from the income of other speculators back to the banks was one of the major causes of the recent period of prosperity and of the present period of depression.

It is not the intention of this article, however, to imply that brokers' loans are the sole cause of the present depression, but merely to expose the undercover channel through which bank credit flowed into uses which are not ordinarily considered proper and to point out the economic consequences of this flow. The total of brokers' loans, hence, represents not the amount of credit used by speculators at the expense of legitimate business, as is so often contended, but rather the amount being put to illegitimate uses by business at the expense of speculators.

WILFORD J. EITEMAN

ALBION COLLEGE

CAPITAL PRODUCTION AND CONSUMER-TAKING: A FURTHER WORD

AN APOLOGY is in order for continuing my discussion with Professor Frisch; and such a continuation would not be justified unless it could further the development of the discussion toward a constructive outcome. There is no difference between us as to the proper formulation of the principles involved, in their simplified mathematical form. There may, however, be some difference as to the importance we attach to the different elements in this mathematical relationship, and as to its application to the complicated movements of the business cycle. It is in the hope of clarifying these latter matters that a further word may be justifiable.

The question at issue is the relation between fluctuations in the rate of growth of demand for finished products, on the one hand, and the corresponding fluctuations of demand for durable means of production to make these products. The special point in question is whether demand for durable means of production necessarily suffers an absolute decline as soon as demand for finished products slackens its rate of growth, or whether, as Professor Frisch correctly contends, a slight slackening in this rate of growth may be offset by an increase in depreciation—or, to be more accurate, in demand for replacements.

Before proceeding, it may be worth while to point out once more that what Professor Frisch designates as my "first formulation" of the principle was not the first formulation I made of it. The "second formulation" he criticizes as still not quite satisfactory because it does not include the elements he wishes to introduce; namely, "the depreciation rate and the actual size of the growth rate of consumer-taking." He is speaking, however, of a single sentence, which does not constitute the full formulation. The following sentence of my statement deals with the elements which Frisch wishes to include, and does it in terms of Frisch's own arithmetical illustration. So there seems to be no controversy remaining on this score—if there ever was one. In that connection it would be well to call attention to an accidental omission in my succeeding sentence. Instead of saying: ". . . . demand must never shrink more than one-half of 1 per cent in any year," the statement should be: ". . . . the rate of increase of demand must never shrink by more than one-half of 1 per cent." It does not require a "*sudden* and

violent drop in consumer-taking" (as Frisch suggests) to call the principle into action, but only a very slight decline in the rate of increase, such as is inherent in the natural irregularities of all forms of human growth.

One further qualification should be made. As already noted, instead of "depreciation" it would be really more accurate to speak of the need for replacements; and it is not strictly correct to assume that this is necessarily increasing because the volume of equipment is at present growing. The need for replacements depends on the volume of equipment constructed twenty years ago—if its life is exactly twenty years—and this may have been increasing, decreasing, or standing still. The effect of this fact is further blurred by the fact that different units will wear out after different periods of service.

But the correction which these facts necessitate is dwarfed by other disturbing elements which enter into any application to actual business cycles. There are other reasons why the peak of production of capital equipment should lag behind the point of greatest increase in consumer demand, and by a longer interval than the mathematical formula suggests. It takes time to formulate plans, carry through the necessary financing, place orders or let contracts, and carry the work to completion. And these factors serve to explain, in part, why the peak of capital construction comes nearly a quarter-cycle later than the formula would indicate, coinciding more nearly with the peak of consumer demand than with its point of maximum rate of increase. These factors also undoubtedly have a great deal to do with the duration of actual cycles.

For a full explanation, however, one must take account of factors acting in the reverse direction, namely, the fact that actual movements of consumer demand depend on the movements of purchasing power; and these in turn are governed by the rate of production in general, including that of capital equipment, and also that of durable consumption goods, such as housing and automobiles, to which the same essential principle applies.

Thus, if we take as our initial fact a moderate decrease in the rate of growth of consumer demand (such as needs no particular explanation), this may result—with a lag—in a positive decline in rate of production of durable producers' or consumers' goods. This in turn reduces purchasing power, unless offset by opposite movements elsewhere, and results in a positive decrease in consumers' demand, presumably extended to more commodities than those originally affected. And this in turn further extends and intensifies the shrinkage in production of durable goods, etc. This may serve as an answer to a criticism

of this theory, made by Dr. C. O. Hardy before the American Statistical Association last December, to the effect that the theory presupposes a cyclical alternation of expansions and contractions in consumer demand, and leaves these movements to be explained. As stated above, the actual contractions (and the more rapid expansions), if they do not arise as original movements produced by "outside causes," can be explained as results of an intensifying mechanism whereby a fluctuation in the rate of growth may be converted into alternations of rapid expansion and absolute contraction, through the interaction of the two sets of forces indicated. It may also be mentioned that other enabling causes, such as elastic credit, are necessary to this result, even on a strict theoretical basis; not to mention the many forces which, whether theoretically necessary or not, play a part in the actual process.

We have, then, a problem of mutually interacting forces, returning on each other in a vicious circle of cumulative disturbance. Viewed from this angle, the challenging problem is not why there are cyclical fluctuations but why there is any limit to the fluctuations short of zero, on the one side, or the full capacity of existing productive equipment, on the other. If there is a determinate limit short of these ultimates, it would seem that it can most easily be explained on the assumption that consumers' expenditures fluctuate less than does the income derived from productive activity. The problem of defining limits of fluctuation on this assumption seems to be one to which the techniques of mathematical analysis are peculiarly adapted; and I sincerely hope that this discussion may stimulate some mathematical economist to produce a solution. It seems to be one of those cases in which the total effect of an original impulse, returning on itself and reinforcing itself in a dwindling series of increments, may still be a finite quantity. Another possible explanation runs via the limits of the elasticity of credit. Both factors are presumably important.

Other questions remain: for instance, why Frisch considers the critical interval of the business cycle to be that interval in which consumers' purchases are increasing at a decreasing rate while production of equipment has not yet begun to decline. One wonders also whether it is possible in an actual statistical curve to locate the first slight decreases in the rate of increase of consumer purchases with sufficient nicety to determine this critical interval according to Frisch's formula. Monthly figures, with their inaccuracies and somewhat spasmodic movements, complicated by seasonal cycles, would seem to be rather too crude instruments for such delicate determinations.

COLUMBIA UNIVERSITY J. M. CLARK

CAPITAL PRODUCTION AND CONSUMER-TAKING: A FINAL WORD

MAY I recall that the simplified assumptions underlying our discussion (and stated mathematically in my notes) are Professor Clark's own assumptions. What I did in my previous notes was only to point out that the attempt made by Professor Clark and others to deduce the turning point of the business cycles as a consequence from these simplified assumptions is bound to fail. Indeed, as here formulated, the problem contains three variables and only two equations and hence is indeterminate. To clarify this point was the purpose of my notes, and it seems that there is now perfect agreement on this score.

With a view to practical applications it will, of course, be desirable to make the picture more realistic by qualifying and modifying these simple assumptions in various ways. Some qualifications and modifications of this sort are now introduced into the discussion by Professor Clark in his last note. And I believe I am in agreement with most of what he says in this connection. This latter discussion cannot, however, make the theory any more determinate than it was before, because there are now introduced at least as many new variables as new conditions.

The challenging problem described by Professor Clark in the last part of his note is, indeed, an interesting one. In this connection I may mention that there exist theoretical set-ups that involve such things as demand and supply elasticities, stocks on hand, the rate of change of price, etc., and that are determinate and actually lead to damped oscillations. The length of the period and the length of the various lags will in general depend in a characteristic way on the magnitudes of the demand and supply elasticities and on certain other structural data of the problem. (One such set-up I discussed in my lectures at Yale University in 1930.)

Great care must, however, be exercised in interpreting such theoretical schemes, because it is possible to construct *many different schemes* that all lead to swings similar to those we observe in our statistical data. By what criteria can we recognize the scheme that gives the "correct" explanation? The systematic development of such criteria will form, I believe, a new and essential part of the business-cycle studies of the future.

RAGNAR FRISCH

UNIVERSITY OF OSLO

BOOK REVIEWS

A REPLY

Permit me to consider in brief the specific allegations made by Professor Hutchinson in support of the assertion in his review of my study[1] on *The Introduction of Farm Machinery* that "Not a few of Mr. Rogin's statements relating to the history of harvesting machinery are incorrect."

1. He is surprised at my failure to concede the priority of Cyrus McCormick to Hussey in the invention of the reaper.

2. He finds even "more surprising" my failure to reach a definite decision concerning priority in the attachment of a practical raker's seat.

With regard to both of the above, I have merely been tentative where neither my evidence nor the objectives of my study call for categorical answers, even assuming that such answers can be made in the light of evidence discovered thus far. In view of the fact that Hussey preceded Cyrus McCormick both in the patenting and the sale of his machine, the answer to the first question would obviously depend on the meaning attached to "priority of invention." In regard to the second, it is very doubtful if a particular set of documents, to the exclusion of other evidence, can prove conclusively the success of a particular attachment to an agricultural machine. The indefiniteness of the concept *successful*, the partisan attitude of eyewitnesses, the variety of conditions which have to be satisfied (particularly under pioneer conditions), and the nature of historical inference are all against it.

3. I nowhere make a statement to the effect "that the first reaper of Cyrus McCormick was merely an improvement of one previously constructed by his father."

4. I inform the reader in the caption under what Professor Hutchinson calls my "picture of the original reaper" that it is a reproduction of a photograph of a model of the McCormick patent of 1834, made by the Deering Company at the close of the nineteenth century. If it is not a faithful representation of that patent, Professor Hutchinson's ex-

[1] Leo Rogin, *The Introduction of Farm Machinery in Its Relation to the Productivity of Labor in the Agriculture of the United States during the Nineteenth Century* (1931), reviewed by William T. Hutchinson, in the June, 1932, number of this *Journal*, pp. 403–5.

pert opinion to that effect would be of value. His other representations are irrelevant.

5. Both my common sense and the surrounding evidence led me to accept Cyrus McCormick's statement that his reaper was "not of much practical value until the improvement of my second patent in 1845" as adequate explanation for his failure to sell many machines prior to that date. Professor Hutchinson reproves me severely for failing to include a statement made shortly after by Hussey "that he [Hussey] had been working to 'give to the world a good Reaping Machine, which I have done just at the expiration [1847] of my Patent.'" I have been too long away from research into this matter to know whether I missed the foregoing statement (as I must have missed much other evidence which Professor Hutchinson's decidedly more intensive research into the personal and technical history of the early reaper must have discovered), or whether it merely appeared to me then, as it does now, not nearly so enlightening as Mr. McCormick's statement. I quote Hussey and indicate otherwise the inadequacies of the early Hussey reaper.

Professor Hutchinson points to the omission indicated in (5) as a "last example of the errors resulting from a reliance upon biased source materials." If my interpretation of evidence, much of it necessarily biased, has possibly been less shrewd than that of Professor Hutchinson, the tone of his review leads me to suspect that it has possibly been less partisan.

LEO ROGIN

UNIVERSITY OF CALIFORNIA

Exchange, Prices, and Production in Hyper-Inflation: Germany, 1920–1923. By FRANK D. GRAHAM. Princeton: Princeton University Press, 1930. Pp. xix+362. $3.50.

Though Professor Graham concerns himself largely with the causes and consequences of monetary inflation in Germany during the post-war years, he also attempts a revision of the "orthodox" doctrine of the relation between money, prices, and exchange rates. In Part I, treating of the "Historical Background," the author devotes his attention chiefly to the "factors in inflation." He finds that "certain alleged causes of depreciation such as speculation, or the losses of territory, population, and resources under the Treaty of Versailles, had almost no real influence, and that but a very slight measure of responsibility can be laid at the door of the private banking organization" (p. 76). His

positive conclusions are not nearly so clear-cut: the view is advanced that payments on reparations account exercised a pre-eminent influence on the decline of the mark exchange rate, and that the impact of the declining foreign exchanges on the treasury led to internal currency depreciation; but though this view is dominant, it is hedged about by so many qualifications that the final impression is vague. Graham has failed to emphasize sufficiently the influence of the big industrialists on the conduct of the German state finances; it is they who had most to gain from inflation, and their responsibility for the internal depreciation of the mark was certainly great. Furthermore, Graham's analysis suffers throughout from a tendency to approach the causes of inflation normatively: for example, although the loss of German territory should not have exercised any influence on inflation, it is not certain that it did not, for it may have created a psychological setting which made inflation easily possible.

In Part IV, on the "Effects of Inflation on the German Economy," Graham limits the inquiry to the effect of inflation on the size of national income; he does not take up, except incidentally, the effect of inflation on the distribution of wealth and income. A quantitative study is made of the "material" gains and losses arising from inflation. The conclusions reached will be startling to many. Hitherto, it has been very generally assumed that hyperinflation invariably leads to enormous economic wastage: that it checks savings, misdirects the flow of capital, lowers the efficiency of the agents and appliances of production, stimulates trading at the expense of industrial activity, and tends to deplete the nation's stock of goods through an artificial bounty on exports. But Graham finds that in the German case the "returns from the sale of money abroad much more than balanced the losses on international trade in merchandise and capital items, and domestic production seems, on the whole, to have been substantially greater than would presumably have been achieved under a stable monetary standard" (p. 321). Only in the very last stage of the inflation period does Graham discern any adverse influence: "Not until the final three months of the paper mark régime can a deleterious effect on industry be clearly traced to the collapse of the currency" (p. 318). To be sure, production during the years of hyperinflation was considerably below pre-war levels; but Professor Graham argues that this is to be attributed to the war, which left the nation's productive equipment and industrial population in a deteriorated condition. Graham's conclusions are supported by extensive data; but unfortunately

they throw practically no light at all on the qualitative aspects of German production during hyperinflation. Certainly, the inflation led to a good deal of ill-considered production, and the author's conclusions would have been more significant if he had seriously attempted to allow for this factor.

In the theoretical section of the book (Part II), Graham copes with the central problems of monetary economics: first, the relation between changes in currency and in the general level of prices; second, the relation between movements of the foreign exchanges and the domestic price level. The core of the inquiry into the relation between money and prices is a new concept of velocity of monetary turnover, which is offered as a substitute for the customary concept of "the ratio of money expended to the average money on hand, or the number of times money changes hands, in a given period" (p. 108). The central ideas connected with the new concept of velocity are contained in the following quotation:

> The essential feature of monetary turnover . . . . is not how many times the money supply is used in a given period but how large a proportion of it is in process of transfer at the time of maximum demand. There are peak loads in the requirement for money, and prices will be conditioned by the proportion of the total money in circulation which can be mobilized for the peak volume of transfers as well as by the proportion of total business done at the peak. . . . . As not all people will completely divest themselves of money, ... prices cannot rise to the level at which the total value of the transactions occurring at the moment of greatest trading would be equal to all the money in being at that time. The latter condition is, however, the absolute maximum of rate of monetary turnover [pp. 109, 111].

Graham does well to reject the customary concept of monetary velocity as a causal factor in general price movements; though he does not go far enough when he states that monetary velocity, as ordinarily conceived, "may or may not be of any influence on prices" (p. 108). Monetary velocity is not a causal factor in general price movements, for it is a calculated quantity and not an element of direct experience. The causes of movements in general prices operate (among other channels) through the volume of monetary payments and volume of currency, of which monetary velocity is the quotient. When monetary outlays rise in relation to the quantity of currency, monetary velocity automatically increases and prices tend to rise; but it is the increased outlay and not the rise in velocity which causes the rise in prices. But Graham's concept of monetary velocity is even more dubious than the

customary concept. He apparently thinks of monetary turnover as referring to an instant of time, which is a somewhat bizarre notion of turnover. The maximum rate of monetary turnover, on the basis of Graham's concept, is unity, whereas in the customary conception, the maximum is indefinite—infinity, if you like. Graham does not cling consistently to his own concept: when he measures monetary turnover, he employs the customary definition, and in analyzing his figures of turnover he states (p. 107) that in 1923 a rate of turnover "very close to the absolute maximum had been attained," and that in "August, September and November 1923 . . . . the 'ceiling' in the rate of monetary turnover had been reached"—forgetting that infinity now constitutes the ceiling, whatever that may mean. And it will be noticed that the idea of fixed limits pervades the foregoing citation: the author apparently regards the quantity of money in existence at any one time as a constant, which, of course, is never the case, for the amount of credit which can be put to work at any one time is indefinitely large, and there is, therefore, no ceiling to prices.

The central feature of Graham's analysis of the relation between foreign exchange rates and domestic prices is the distinction he draws (p. 130) between "absolute" and "conditional" demand for foreign exchange: the first grows out of transactions which have already been entered into and which call for payment in order to be completed; the second grows out of transactions which are being contemplated. This distinction is quite formal, in part even legalistic: "absolute" demand for foreign currency is absolute only in the sense that foreign currency has not yet been acquired, and must be, by the final date of payment; and a good deal of "conditional" demand is "absolute," in the author's sense, as it is recurrent and predictable. Graham argues (p. 136) that "conditional" demand always is, while "absolute" demand may or may not be, an equilibrating force in the markets for foreign exchange. He analyzes "absolute" demand with the aid of a number of arithmetic examples, which proceed on the assumptions that two countries—one on a gold, and the other on a paper, standard—are engaged in foreign trade, that the amounts of the "absolute" demands for foreign currency are given, that no demand whatsoever of a "conditional" character can arise, and, most important of all, that the systems of invoicing goods differ. The conclusion is reached (pp. 136–44) that, under the assumed conditions, the movements of exchange rates are self-limiting when goods are invoiced in the currency of the buying country, self-inflammatory when goods are invoiced in the currency of the selling

country, and neutral when imports and exports are invoiced in the same currency unit.

The author makes a good deal of this conclusion: he claims (p. 137, n. 8; p. 143, n. 13) that it illuminates the movements of mark exchange in the period of hyperinflation; but it is very doubtful whether an analysis based on the extremely unreal assumption of no "conditional" demand can adequately clarify any actual situation. Judged even as a piece of abstract reasoning, the analysis is invalid. If competition in the foreign-exchange market be assumed, the equilibrium rate may be defined as the rate which will make possible full clearance of all current international obligations. Provided only that each set of transactions is viewed completely apart from any past or future transactions—and this is Graham's assumption—the movements of the exchange rate will be self-limiting not only when goods are invoiced in the currency of the buying country but also when they are invoiced in the currency of the selling country; for in either case there will be an equilibrium rate as above defined, and any other definition for the present problem seems pointless. When exports and imports are expressed in a common currency unit, and when these two amounts are unequal, certain of the transactions will remain unpaid for, and nothing else will happen.

Professor Graham's book has an impressive statistical façade throughout, and almost all of Part III is devoted to statistical measurements. But any careful reader will be disturbed by the defects in some of the major statistical efforts. Thus, the index of monetary turnover, which Graham himself designates as "rough," was constructed by dividing an index of commodity wholesale prices by an index of money in circulation, month by month (pp. 103–6). This is an index of monetary turnover only on the assumption that the volume of trade is a constant; otherwise, it is an index of the ratio of monetary turnover to volume of trade. Quite apart from this consideration, Graham's index is probably very far from the truth. In the first place, wholesale commodity prices advanced at a very much faster rate than general prices; secondly, the figures of money in circulation do not include foreign currency or illegal emergency issues which reached stupendous volume toward the close of the inflation period; and, thirdly, in an inflationary period there will be a persistent and systematic inequality between the two sides of the equation of exchange when the statistical measures of its several terms refer to the same month, since the volume of payments in any one month will tend to be lower than the value of goods transfers in that month. These several factors are cumulative, as each of them makes for excessively high figures of monetary turnover.

Or, take some of the indexes of prices that constitute the foundation of much of the analytic work. The most vulnerable is the index of prices of export commodities, which is based on machinery alone (p. 182). The indexes of prices of imported goods and domestic goods may be better; but apart from stating that the number of components is small and that some of the series are defective (p. 182), the author leaves the reader in the dark as to the composition of these indexes. The index of "external prices" (pp. 155–59) was constructed by multiplying the index of the dollar exchange rate (expressed in marks) by the U.S. Bureau of Labor Statistics index of wholesale prices; but such an index of external prices is, if anything, a measure of the potential changes in the external purchasing power of the mark, and not of actual changes: an index of the actual external purchasing power of the mark would have to rest on the "bundle" of imports into Germany, and not on a "bundle" of goods which is representative of domestic trade in the United States. Clearly, the ratio of an index of external prices (as defined by Graham) to an index of internal commodity prices is identical with the ratio of the purchasing power parity of the mark to the mark exchange rate. But if the reader will compare Chart IX, which gives the purchasing power parity as a ratio to the exchange rate, with Charts XXIX–XXXII, which give the ratio of external prices to internal prices, he will find that the movements of the two differ considerably; and also that the first terminates in August, 1923, for the reason that "from September 1923 till the end of inflation German exchange rates were nominal only" (p. 120), while the second continues through 1923. This statistical inconsistency prejudices the author's entire analysis of foreign trade during hyperinflation, inasmuch as this analysis rests very largely on the movements of the ratio of external to internal prices.

Graham declares that coefficients of correlation are of "questionable value" (p. 190) for his purposes. Yet, he reports his extended computations of them over a number of pages, presents the coefficients to three decimal places, and supplements the coefficients with probable errors computed to the same number of places. The coefficients of correlation frequently belie the graphs (Charts XXI and XXIII); and the probable errors are, of course, sheer nonsense. Coefficients of correlation are used extensively in some parts of the book to measure the degree of correspondence between the "cyclical" fluctuations of various series; but what the meaning of "cycles" derived from "trend" lines fitted to periods running from one and one-half to four years may be is not clear; and Professor Graham renders little assistance when he states that,

although "the use of the words 'trends' and 'cycles' may be questioned . . . . it seemed best . . . . to avoid the awkward circumlocution which accurately descriptive expressions would necessitate" (p. 190). Despite the warning that his coefficients of correlation are of "questionable value," Graham shows (pp. 202, 207, 233–34) an inclination to accept them when they harmonize with his scheme of things, and to reject them when they do not.

ARTHUR F. BURNS

RUTGERS UNIVERSITY

Capital Imports and the Terms of Trade Examined in the Light of Sixty Years of Australian Borrowings. By ROLAND WILSON. Melbourne: Melbourne University Press, in association with Macmillan & Co., Ltd. 1931. Pp. viii+111.

Dr. Wilson has made a careful and thorough study of capital imports into Australia and the terms of trade from 1871 to 1930. The statistical data have been selected with full regard for the difficulties attendant upon the gathering of such material. The calculation of the balance of international indebtedness from 1904 to 1929–30, and the use of the excess of credits as an indirect estimate of borrowings is noteworthy. He has also computed capital imports directly from figures of new capital flotations and movements of bankers' balances between London and Australia very ingeniously.

The index of the terms of trade has serious limitations, it is pointed out, and he says of it that it

> does not show unequivocally that Australia "gained" when it rose and "lost" when it fell; that it is unlikely to have been affected materially by the import of capital into Australia; and that no theoretical grounds exist for expecting any *possible* effects to have been necessarily of such a nature as to promote a positive correlation between the "net terms of trade" and imports of capital (p. 101).

But some verification is found in the Australian experience "for the propositions that imports of capital *tend* to be positively correlated with increases in the ratio of the 'domestic' price-level to the price-level of 'international' commodities" (p. 106).

The theoretical treatment in Chapter IV is an important contribution to the literature of international trade. It is held that the ratio of import to export prices is a defective measure of the barter terms, since a reliable index is impossible of attainment. During a period of

heavy borrowing, there will be important shifts of commodities from the class of international goods to that of domestic commodities, or vice versa. How then, it is asked, can we make valid comparisons between the price levels of international goods in the borrowing country when dealing with a set of commodities which have changed in composition and nature during the period? This problem does not seem to me to be insurmountable, however. Dr. Wilson points out that if varying quantities of a single homogeneous commodity were exported throughout the entire period from the borrowing country, there would be no serious statistical difficulty with respect to selection and weighting. Since borrowing countries are largely of the "new" type, with relatively few exports of the staple kind, the problem may be solved partially at least. With imports the case is more complex, although to the extent to which imports are of standardized capital goods a solution is also possible.

The terms of trade indexes are subject to a further theoretical difficulty, since two types of factors affect the ratios. The first is that changes may occur because of alterations in the real costs of production, and Dr. Wilson shows that Marshall's use of "bales" representing comparable units of productive power was an attempt to isolate this factor from the second force, although not a very successful attempt from a practical viewpoint. The second factor is the shift in reciprocal demand due to changes in the bargaining ability of countries. It is impossible to separate the two forces, and, consequently, the index of barter terms lumps together changes due to both, although in studying the effect of loans on the terms of trade, it is desired to consider only the second factor. This is an undoubted difficulty, but I am doubtful about the further assertion that for the purpose of isolating the second force the proviso that "other things remain the same" cannot be applied when historical data are used (p. 51). It is suggested later (p. 68) that conditions of constant cost are perhaps not improbable for the *classes* of goods—international and domestic—and if that is the case, isolation of shifts in bargaining strength is achieved.[1]

[1] A further assertion is made that the "welfare" significance of changes in the net terms of trade differs depending on whether the factors inducing them are internal or external to the country concerned, and that there is no hedonistic gain where the changes have arisen from within. However, where a change in demand arising in country A for the products of country B leads to an increase of production under conditions of decreasing cost in B, a hedonistic gain may result for A as the terms of trade ultimately shift in its favor. Of course, this is not a gain due *directly* to the initial change in reciprocal demand, but is, nevertheless, a real one.

In discussing the relation of the terms of trade to capital imports (pp. 56–62) the two cases cited by Taussig[2] with respect to a tribute are considered. The significant portions of the cases are reproduced here:

Case I	Case II
German demand for wheat is inelastic	German demand for wheat is elastic
U.S. demand for linen is elastic	U.S. demand for linen is elastic

Dr. Wilson maintains that while Taussig has assumed that Case II is the converse of Case I, that actually a third case is the true opposite, and that a fourth is possible:

Case III	Case IV
German demand for wheat is elastic	German demand for wheat is inelastic
U.S. demand for linen is inelastic	U.S. demand for linen is inelastic

From a taxonomic point of view the criticism is justified, but from a quantitative standpoint, Case II may properly be said to be the converse of the other three cases. Adjustment of trade in the fundamental sense is possible in Case I, II, and III,[3] but it is more likely to be reached easily under the conditions of Case II, where a relatively small movement of specie would be sufficient. In Case III, for instance, adjustment will occur readily only under the somewhat improbable assumptions that the elasticity of demand on the part of Germany for wheat is very great, while the elasticity of demand on the part of the United States for linen is very close to unity. The converse would be true of Case I. Unless these conditions are fulfilled, a very substantial movement of specie would have to occur in order that adjustment might take place.

It has been indicated by Dr. Wilson that the domestic demand for linen in Germany and the domestic demand for wheat in the United States should not be neglected; and that the application of net barter terms to unit relationships between quantities of imports and quantities of exports irrespective of the *total* quantities of the commodities available is meaningless. Easy adjustment of trade, however, remains at least as probable under the assumptions of Case II, when total quantities and domestic demand are considered, as under the condi-

[2] F. W. Taussig, *International Trade*. New York, 1928, pp. 110–15.

[3] Case IV is shown by Dr. Wilson to be an impossible one for the ascertainment of a new equilibrium, unless the flow of specie is very great, and important shifts occur in the demand curves for both goods and money in the two countries. And it would bring *unfavorable* terms for the country receiving the tribute (p. 61).

tions of Cases I and II, especially if we assume that the domestic demand is similar so far as elasticity is concerned to the foreign demand (the most probable assumptions), i.e., the demand for wheat in the United States will be elastic, and the demand for linen in Germany will also be elastic, under the conditions of Case II.

The most important conclusion reached by Dr. Wilson is that there are no theoretical grounds for the belief that a shift in the net terms of trade in favor of the borrowing nation is essential to the transfer of the loan in goods, or a necessary consequence of the borrowing operation. He lays stress on the point that the prices of international goods will not be affected to any great degree by changes in commodity movements between a borrowing country and a lending nation, because the elasticity of world-supply to a single country and the world-elasticity of demand from a single country are each very great. Primary emphasis is placed on the shifting of domestic prices relative to international goods in general, rather than on the relative movements of import prices compared to export prices.[4]

Several objections may be raised to the reasoning and conclusions in this respect. I am doubtful as to the volume of commodities which may properly be classed as domestic goods, and unless their volume is large relative to international goods in general, trade adjustment would be very difficult without shifts in the ratio of import to export prices. In emphasizing demand, there is a tendency to neglect the play of costs of production upon prices, and too little account is taken of the possible shifting of the factors of production from one use to another. Moreover, it is assumed for purposes of analysis, that costs are constant in the long run (although this assumption is later relaxed), and that the short-period supply curves for each class of goods (international and domestic) are positively inclined. Unless the existing plant is utilized precisely to capacity, falling costs may occur as readily as rising costs as output increases, and for trade adjustment short-run factors of this type are of great importance.

Without attempting to go into the detailed analysis of the problem, I am dubious as to Dr. Wilson's conclusions on pages 76–77. After reasoning that the initial effects of borrowing will be to increase the prices of domestic goods relative to international trade goods in gen-

[4] The technique worked out in terms of arithmetric notations (+ and − signs) seems to me to have no superiority over the use of numbers, and in later cases Dr. Wilson returns to the use of numbers with exponents to indicate the degree of change, which is a useful procedure.

eral, he maintains that the flow of specie presumed by the classical theory of trade will not tend to cause a rise of export prices relative to import prices in the borrowing country, despite the fact that prices of productive services will tend to be the same in both domestic and export industries. Since the prices of domestic goods have risen relatively to exports, there will be a tendency for demand to be transferred to the export goods, and other things being equal, the prices of exports should rise. But he maintains that this will not be true because any rise in export prices will serve to discourage the tendency for demand to be transferred from domestic goods, and will further discourage the purchase of exports by the lending nation, and lead to a transfer of demand to domestic goods in that country. At the same time there is a tendency for productive services to be transferred from export industries to domestic industries. "While the supply of C (export goods) may thus tend to diminish, demand for C goods tends to diminish at the same time, and prices to remain unaffected" (p. 77). The same type of forces will operate to prevent import prices from falling. Apart from any changes which might be introduced if full account were taken of plant utilization and its effects upon costs, and the fact that the shift of productive services is a slow process and subject to long-run rather than short-run cost conditions, it is possible that the prices of exports might remain high until all exports from the borrowing country had ceased. Undoubtedly, shifts of this kind from the export class to the domestic class are very important in trade adjustment, but it is unlikely that exports would cease entirely. And so long as *any* tendency remained for demand to be transferred from domestic goods to export goods, and for a shift of capital from export industries to domestic industries to go on, the prices of export goods would remain high. Unless the diminished imports by the lending country just balanced the transfer of purchasing power from domestic goods to export goods in the borrowing country, there is no reason to expect that prices of exports would remain in the position reached after the initial effects had occurred, i.e., low relative to domestic prices. And even if this were true, there would still be a tendency for productive services to be transferred to domestic industries, and the equilibrium could not be a stable one.

W. Edwards Beach

Williams College

Borrowing and Business in Australia. A Study of the Correlation Between Imports of Capital and Changes in National Prosperity. By GORDON WOOD. London: Oxford University Press, 1930. Pp. xv+267. $4.75.

The historical material incorporated is interesting, but aside from the fact that cyclical fluctuations in international borrowings had important repercussions upon Australian finance and trade, it has little significance for the problems of verification of international trade theory. As an inductive study of the relations of capital imports to the barter terms of trade and sectional price levels, the book leaves much to be desired. The data for capital imports, which do not include transfers of bankers' balances, are not compared directly with changes in the barter terms, and wages alone are plotted against the terms of trade on the charts.

The compilation of the statistical data is slipshod, and the methods of constructing price indexes are not fully stated. The data on capital imports used in the chart on page 187 are not given; the only figures relating to borrowings for the period appear in the tables on pages 169 and 186, but are not the ones plotted. The use of *smoothed* five-year moving averages on many of the charts obscures the facts in many cases; and there is no warrant for the extrapolation of the curves. In particular, the charts on pages 128 and 187 may be noted. The high inverse correlation of capital imports to exports as a percentage of imports shown by the smoothed curve on page 128 is at least doubtful; while the inverse correlation clearly shown by the raw data for the chart on page 187 has been transformed into a high positive correlation by the smoothed curve.

The chapters (xiii–xvi) on the war and deflation periods are based almost entirely on a single secondary source, despite the material available in British *Parliamentary Papers*, the Australian *Parliamentary Debates*, the reports of the Imperial Economic Conference, 1923, Canadian *Sessional Papers*, etc. Nor is consideration paid to the war expenditures of the Australian government abroad, or the accumulation of balances in London, as affecting the Australian balance of payments. The Federal Reserve authorities are erroneously stated (p. 215) to have begun a policy of deflation in 1918, and said to have achieved a notable appreciation of the dollar by 1919.

W. EDWARDS BEACH

WILLIAMS COLLEGE

Economics in the Twentieth Century. By THEO SURANYI-UNGER. Edited by EDWIN R. A. SELIGMAN. Translated from the German by NOEL D. MOULTON. New York: W. W. Norton & Co. Inc., 1931. Pp. xx+397. $5.00.

One is glad to agree with the laudatory words regarding the author in Professor Seligman's Foreword to this book, as to his linguistic and scholarly attainments, philosophic background, and freedom from bias, but it is not so easy to feel unqualified enthusiasm for the book itself. Perhaps the chief impression made by it is to emphasize the difficulty of the task. It may be doubted whether anyone could perform it in a way which would provoke more praise than criticism from most economists, and Professor Suranyi-Unger has probably done it as little to the general dissatisfaction as human possibility admits. One is reminded that the literary product of an economist is a body of doctrine, the interpretation of which is doubly controversial in comparison with the economic reality on which it is based. For an author will differ with any critic (and critics will differ among themselves) as much on the question of what has been said as on that of what ought to have been.

The scope of the work, imposing as it is, is not as inclusive as the title; it surveys in its three main "parts" the theoretical economics in the German, French and Italian, and English languages, in the present century. (Thus the author's native country, Hungary, is omitted.) These divisions are preceded by a ten-page Introduction comparing the development in the different countries, and by "Part One" (28 pp.) on "The Philosophic Sources of the Most Recent Economic Tendencies." It is the author's contention that the economic thought of each country is definitely of a piece with its literature and general culture, and that while the divergent growths are fruitful, a more effective cross-fertilization than has actually obtained is to be desired. The analysis in the ten numbered sections of Part I is not invulnerable to criticism. The connection (sec. 4) of Comte and Spencer with the notion of economic equilibrium is undoubtedly important, but is rather indirect and should be explained, not merely asserted. The direct root of the doctrine lies elsewhere, in the urge to employ mathematics. The relation of "The Utilitarian Ethics, Cambridge School, and Economic Liberalism" (sec. 5) to Spencer is obscured, and the connection of both with "Austrian" doctrine passed over. The longest of the sections is the last, on American institutionalism, where it is

surprising to find all the emphasis on (German) experimental psychology, Spencerian evolutionism, and English associationism as the source of "the new American psychology," with bare mention of the relation to (German) historical economics; also to find no mention at all of the kinship between Commons' legal economics and the German movement under Stammler and Diehl, or of the third distinct movement confounded with institutionalism, i.e., the emphasis on statistical content and treatment. This discussion of international contrasts and contacts and of movements and their roots and meanings is continued in the 27-page "Summary and Prospects," essentially a fifth "Part," though not so captioned. Of this, the last fourth is given over to the theory of marginal utility, somewhat dubiously asserted to have been "created and developed principally by Austrian economists" (p. 332—cf. also the comparison between Jevons and Menger, p. 335).

Regarding the main body of the work it is possible to notice only the form. In each of the parts, dealing with a "Sprachgebiet," the material is forced into the same mold of five chapters, on "Method," "Systematizing Conceptions," "Value," "Price," and "Distribution." The second and fifth get nearly a third each of the material in each case, and it seems that the apportionment corresponds to the interests of the critic rather than to that of the original authors. Of the 800-odd names occurring in the Index, the majority get only one page reference, while important authors are cut up and distributed. The separation of method from systematizing conceptions is forced, and that of value from price more so; if a uniform scheme seemed essential, one of three headings instead of five would have been better. (An author's own mapping of the field is surely a vital feature of his work.) Sections within the chapters are based more directly on the material, but these also show a straining after classification. After all, some scheme being necessary and no possible one satisfactory, the outline used enables the author to arrange an incredible amount of material in the space taken, with an impression of a relevant connection; it meets, if it does not solve, the problem set, of combining a dictionary and a readable exposition. Regarding reference use, one must protest violently against the arrangement adopted by the publishers of the translation. Footnotes have been transferred from the page to which they relate to the end of the book, with no ready means of finding the note from the reference figure. The reader has the tedious job of paging these 44 pages of notes to make reference possible—not convenient, even then. In the same connection, the Index should have been more than a list of names.

In general, the reviewer feels that the book is useful as well as amazingly erudite, but that its value would be greater if the material were clearly related to a stated critical conception of the nature and task of economic theory. The effort to avoid bias, and especially negative criticism or comparison, tends to make the exposition colorless. It is possible to discern that the author's interest centers in the problem of economic individualism, as appears particularly in the ever recurrent references to Spencer and to Spann. No doubt this is the basic philosophic issue confronting theoretical economics today. If the relation of the work criticized to this issue were made central, it would have to be recognized that most of the non-German writers (prior to Fascism) have taken an individualistic position uncritically or even unconsciously, and their contributions would have to be appraised accordingly. On the individualistic side, Spencer is perhaps the best single name to represent the social philosophy in question, if his relation to economic literature were made clear. On the other side, it is less defensible to assume as the alternative to individualism the abstract, metaphysical universalism of Spann. Professor Suranyi-Unger is undoubtedly influenced by the fact that universalism (divested, we assume, of extremist formulation and of association with nationalistic propaganda) has merits in principle which its opponents dogmatically ignore, notably in its own home, which happens to be that of "Austrian" orthodoxy; also by the further fact that the obvious unreality and other limitations of marginal utility are similarly ignored. However, it would surely give a better perspective to place more emphasis on the concrete historical reality of culture (institutions in a broad sense) and on the social nature of the individual, after the manner of Sombart and Max Weber's school. It is seemingly too much to ask that the complementary relation between the two viewpoints and their relevance to different sets of problems be recognized and taken as the starting point of discussion and criticism.

The translation is generally acceptable, though the German frequently shows through, and there are such crudities as the statement (p. 320) of the alleged fallacious assumption of utility theory, "that consumption goods can be shared at will [subdivided indefinitely] and that our valuations are continual [continuous] functions of the amount . . . . possessed."

FRANK H. KNIGHT

UNIVERSITY OF CHICAGO

The Development of Economic Doctrine: An Introductory Survey. By ALEXANDER GRAY. New York: Longmans, Green & Co., 1931. Pp. 384. $2.00.

Professor Gray has written a book for which teachers of economic theory will be extremely grateful. Its field of service will be much wider than he has claimed for it in his overmodest Preface. He set himself the task, as he states, of writing, not a textbook in the history of economic thought for the use of classes in that subject, but a book to be read and used for reference by the undergraduate beginner in the study of theory as such. Few students of more advanced age can afford not to read it carefully, and the scholar in the field will find all of it suggestive and a pleasure to read. Professor Gray's chapters are surely better from any critical standpoint than the material covering the same ground in the larger works to which he defers by name, and that is, unfortunately, saying too little. His own apology for his "survey," on the ground that the larger works (those available in the English language) are "too good" for the purpose he has in view, will undoubtedly be suspected of irony by those who make the comparison for themselves.

The main problem in planning a brief and readable book was, of course, that of selecting the ground to be covered. The principle adopted by Professor Gray is that of mentioning no writer unless he could give space for something like an intelligible account of what he stood for. There will be little disposition to quarrel with this principle, especially as it is by no means followed with slavish literalness. It seems to the reviewer, however, that it might be possible to improve upon it slightly in one respect. The question is whether there may not be, even in the actual working out, an overemphasis on the individual writer as the unit, particularly when we come to the classical school and the nineteenth century. First let us give a brief glance at what is actually done. The first four of the twelve chapters are not organized under the names of men as titles, but deal respectively with Greece and Rome, the Middle Ages, the Mercantilists, and the Physiocrats. It is true that in each case one individual or a very few provide most of the substance. These chapters, like chapter xi on Marx (but really on Socialism), it would be hard to praise too highly. Coming to the period of classicism, we have four chapters under names simply: "Smith"; "Malthus and Ricardo"; "Lauderdale, Rae and Sismondi"; "Müller, List and Von Thünen." Even in these chapters, numerous other writ-

ers are mentioned and briefly characterized; Hume gets the first three of Smith's pages, under a black-face center heading. The titles of chapters ix and x combine school designations with names of individuals: "The Optimists: Carey and Bastiat"; and "The Classical Tradition: Say, Senior, J. S. Mill and Cairnes." Chapter xi, as noted, is headed "Karl Marx" but includes brief characterizations of the leading socialists from Plato down through history, not omitting a long page on socialist criticism of Marxism in recent years. The last chapter reverts to early form and treats of "The Austrian School, the Theory of the Margin." It has black-face headings for Anticipations, Auguste Walras, Gossen and Jevons, and separately for the Viennese triumvirs, who occupy about half the space of the chapter. An Epilogue mentions some writers of the generation since the Austrians and comments on the groping and uncertain condition of economic thought in our own day.

Admittedly, something might be lost in readability by departing still farther from the use of individuals as main topics. Heroic figures naturally lend a human interest to the treatment. Still, I should think that in a chapter on the classical school, comparable to chapters of this general sort in the volume, more could be said in the same space regarding economic thought in the century beginning with the *Wealth of Nations*, without essential loss of interest, and, in addition, making it possible to include reasonable notice of individuals the author reluctantly omitted, and still further bringing in some valuable contrast with the historical point of view. This school was, as the author states to my surprise, "passed over without much misgivings."

It goes without saying that any particular student can find many points of divergence from Professor Gray regarding emphasis. If I were writing fifteen pages on Malthus I should not devote fourteen of them to population doctrine and one to mentioning his place in rent theory, omitting his systematic work altogether. It jars me still more to find no reference to Senior's statement of utility theory, which was nearly perfect in itself, though he unaccountably failed to utilize it to any effect in his system of value theory. Slighting of this and some other remarkable insights of Senior is partly compensated by emphasis on Senior's exposition of the nature of capital and its rôle in production, which, even though again he failed to "follow through," should have saved him from Böhm-Bawerk's imputation of paternity for an "abstinence theory of profit" (particularly as Senior's explanation of profit definitely ran in quite other terms). I should inject a much more dis-

cordant note into the general hymn of praise to Ricardo, though Professor Gray, like many others, manages to take back most of his encomiums after doing his ritualistic duty. And so one might continue at length.

All such queries, however, qualify but little the praise to which the book is obviously entitled. The exposition combines clearness and accuracy with stylistic freshness and charm in an extraordinary degree. (Even though its brightness seems at times slightly forced; perhaps the worst case is again in the section on Senior, where the term "abstinence" is objected to because of association with the word "total"—but again there is a serious point in the connotation of asceticism). Perhaps the best constructive suggestion which may be offered is that the author should publish similar chapters covering the sections of the field excluded by space limits from this volume. These might form a second volume or be included in a parallel enlarged edition not displacing this briefer one.

FRANK H. KNIGHT

UNIVERSITY OF CHICAGO

The French Colonial Venture. By CONSTANT SOUTHWORTH. London: P. S. King & Son, Ltd., 1931. Pp. xi+204. 12*s.* 6*d.*

Descriptive material for the first two chapters of this book is taken mainly from conventional sources, most of them antedating the immense literature brought forth by the Algerian Centenary. The problem of evaluating the French colonies in purely economic terms, for the French people as a whole, is dealt with principally in four chapters (iv–vii, pp. 37–131). Burdens on the French budget are contrasted with the gains from commerce and capital investment. It is assumed throughout—and this assumption is basic to the calculations—that the present French oversea possessions would have been developed as well by other powers if France had stayed out. The general thesis is that the colonies have cost vastly more than they have yielded.

This "necessarily conjectural demonstration" is clearly enough written to enable the reader to formulate his doubts. For example, he may not see any strong reasons for believing that the Frenchmen who have invested in French colonies would otherwise have bought the colonial securities of other nations, together with French Government bonds. The rather ingenious argument is advanced that the decline in gold value of French Government bonds through the revalorization of the

franc was not a national loss in the same sense as the similar fall in French colonial securities, because the first case involved a mere redistribution of capital and income inside the home country. To this simple arithmetic there is the obvious objection that the physical capital exported presumably still exists. It is at least an unwarranted assumption that the capital represented by government bonds is still intact, while that exported to the colonies must be discounted to the extent of its decline in gold value for immediate liquidation.

Likewise the arithmetic for computing gains from trade is so simple as to invite misgivings. Throughout, there is the implicit assumption that the extension of a market leaves the ratio of returns to amounts invested in industry and trade substantially intact. Many specific false impressions are conveyed by the brevity of the arguments. For example, a paragraph on page 72 seems to indicate that durum wheat is the one important item in France's grain imports from North Africa, whereas it is about a third of the total, barley alone being roughly equal to durum. North Africa is judged to be by far the most desirable —or least undesirable—part of the oversea empire.

Whether or not this tissue of conjectures about alternative policies and returns leads to the author's conclusion, there is no doubt as to the value of the elaborate tables of budget estimates, colonial trade, issues and yields of securities, etc. Chapter iv, "The French Budget and the Colonies," is a most excellent brief discussion of this intricate and little-understood subject. Much that might be disputed in this really valuable study is inherent in any scholarly enterprise attempting to appraise items which cannot be isolated, on the inevitable but tricky assumption that "other things remain equal."

M. M. KNIGHT

UNIVERSITY OF CALIFORNIA

Der Sinn des Monopols in der gegenwärtigen Wirtschaftsordnung. By ERICH EGNER. Berlin: Paul Parey, 1931. Pp. vi+143. Rm. 8.50.

This is a significant book. It is typical of the present status of German economics, at least that of the group of economists which claims to be opening a new field of theory. In English, the title means something like "Philosophy of Monopoly"; an eighteenth-century author might have termed it "The Nature of Monopoly." There is a

fundamental resemblance between the way in which Quesnay approached the laws of nature and Dr. Egner's manner in treating the monopoly problem; both seek the normative teleological meaning of all "explanations" and "deductions." Of course, Dr. Egner's philosophy is derived not from Diderot but from Husserl and Heidegger. There is a difference between the naïve rationalism of the former and the sophisticated argumentation of the latter two, who substitute for dogmatic teleology a methodological "point-of-view" teleology. Instead of "explaining" things by eternal and absolute divine ends that were taken for granted in the eighteenth century, this new method tries to relate them to changing ends of different social systems.

According to Dr. Egner, the usual theory of monopoly fails to explain the pragmatic necessity of monopoly in the present economic order, its *raison d'être*. It explains the monopoly price that will prevail under given conditions of the market; it does not explain the reason for the existence of monopoly.

Monopoly is indispensable for the existence of capitalistic national economy, Dr. Egner says, because the introduction of new methods of production is usually connected with functional depreciation of the old investments. This impending loss in capital value would prevent the technical progress of the industry if it were not more than compensated for by monopolistic profits—the "natural" premium for improving the methods of production. Accumulation of these profits soon enables the industry to replace the depreciated fixed capital. On the other hand, the accumulation of monopolistic profits is bound to expand production. The increased supply of goods will lower prices, and the monopoly profit will vanish automatically after having exercised its indispensable service to progress in the social economy.

It would be useless to dispute Dr. Egner's definition of monopoly, to call his attention to other cases of monopoly that seem to lead to retardation of technical progress and waste of capital. He surely would dispose of them as "unnatural."

Dr. Egner's explanation of progress and accumulation does not differ substantially from Professor Schumpeter's well-known theory of economic dynamics. It is only his harmonistic interpretation that is remarkable. It could be characterized as apologetics if Dr. Egner did not give to the whole matter a methodological turn. Monopoly is a reasonable and rational institution from the point of view of the present capitalistic system. But the nature of this economic system is not an absolute one; it can be replaced by another system with a different inherent

nature. This rationale introduces new ends and consequently new means. The same monopolies, which from the former point of view appeared to be rational and indispensable, will become irrational and unexplainable from the new one.

Inevitably the question arises: How is it possible to decide which of the many points of view is to be applied in any particular case and what is the sequence of different economic systems? According to Dr. Egner, this is a metaphysical question; the last part of his book is entitled "Dialectics of Monopoly." It is full of most ingenious methodological discriminations and formal classifications. But we look in vain for a definite metaphysical schemata of sequence in economic stages. The metaphysics of Dr. Egner remains purely formal. He indicates how every theoretical explanation must be attached to the metaphysical clue, but does not indicate how this rationale of a system is to be found.

Sometimes it seems that Dr. Egner is inclined to shift into an immanent psychological or sociological teleology, that is, to identify the ultimate norm with the forces that can be discovered by an empirical analysis of the ends and incentives active in a given economic order. In this case, all his methodological structure would be practically nothing else but a roundabout way leading to the ordinary *homo economicus*, with the "ideal types" of *homo capitalisticus*, *homo socialisticus*, etc., as subdivisions. But, on the other hand, he definitely criticizes the *Idealtypus* theory of Max Weber. Apparently he thinks that men do not always know the "real nature," the metaphysical a priori, of the economic order that they themselves are promoting.

As the "universalism" of Professor Spann is a revival of the German romantic idealism of the early nineteenth century, so the logical normativism of Dr. Egner resembles very much the post-Hegelian theological economics of Rodbertus and Lorenz von Stein. As was remarked above, Dr. Egner is not alone—a whole group of younger German economists is more or less inclined to this kind of economic thinking. Unlike the others, however, Dr. Egner develops his ideas very clearly, so that even the reader who is not acquainted with the mysteries of modern German philosophic terminology can follow his ideas without particular difficulty.

WASSILY LEONTIEF

NATIONAL BUREAU OF ECONOMIC RESEARCH, INC.

Stabilization of the Petroleum Industry. By LEONARD M. LOGAN, JR. Pp. 248. Norman, Oklahoma: University of Oklahoma Press, 1930. $2.50.

In these days of overproduction, maladjusted production, and general economic instability, a specialized study on the stabilization of an industry which has long been out of balance should prove welcome. To those who are looking for a means of bringing about a more rational relationship between the production of oil and its consumption, which will protect the interests of the investor in his earnings, the interests of the consumer in a product at a low cost, and the interest of the community in the efficient utilization of its productive agents, and at the same time give appropriate regard to the claims of posterity on a waning resource, this volume is apt to prove somewhat disappointing. The author does not neglect these problems entirely, but his consideration of them is shaped and limited by his preconceptions—preconceptions which are expressed in an introductory chapter in a group of interesting hypotheses and definitions. The author states:

> Stabilization of the petroleum industry is a two-fold problem, involving both engineering and economics. It is the economic aspect of stabilization that is to engage our attention in this book; in this particular problem, waste and conservation are the two most important elements. . . . . What the oil industry and society are concerned with is the elimination of economic waste. Economic waste is when the economic value of the good produced is less than the cost of producing it.

The problem must be viewed from the social, not the individual point of view; "it must include the total costs and the total returns." The author's definition of waste paves the way for his definition of conservation. Conservation is the antithesis of waste. "Conservation is the preservation of economic values." In the language of the author at another point, it is the creation of scarcity values. Such scarcity values may be brought about in four ways: "increase in wants, niggardliness of nature, increase in production costs, and monopoly." Armed with these conceptual paraphernalia, the author is prepared for his attack on the problem of stabilization. "Stabilization means the withholding of sufficient quantities of oil so that the scarcity value of that obtained when compared with the total scarcity values of the goods which compose the costs of the industry as a whole to the total goods for which they are sold by the industry will leave a profit"—with all that that may imply to the student of economics—or English.

These definitions, if applied consistently, lead to certain interesting conclusions. In the middle of August of last year the East Texas oil field was producing in the neighborhood of a million barrels of oil per day from 1,625 wells. As production had been accelerated, the price of oil had dropped precipitously, some sales having been reported in this field for as little as 5 cents per barrel. The reviewer is of the opinion that such a situation represented waste within the limits of the author's definition. After the calling-out of the Texas state militia and the application of an arbitrary proration program to the field, involving a limitation on total production to 415,875 barrels per day and its distribution equally among the various wells, the posted price of oil was advanced from 20 cents to 68 cents per barrel. Between September and the late spring of 1932, the number of wells drilled in this area had increased to more than 5,400, although the total daily production had been further limited to less than 350,000 barrels. The posted price of East Texas oil had been advanced to 98 cents per barrel. It is quite possible that this was sufficient to cover total cost of production for the field. It is also possible that the stabilization of the petroleum price structure for the country as a whole incidental to the "stabilization" of output in East Texas resulted in a price sufficient to cover total cost of production for the entire country. In brief, "waste" may have been eliminated. The approximately 3,800 wells which had since been drilled in the East Texas field cost, according to a very rough estimate, $80,000,000. Under the program of "stabilization" set up for the field, they have occasioned directly a tremendous decline in output per well. They have increased enormously the cost of producing oil in the East Texas field. But an arbitrary control of output has increased price to such an extent that such destructive practices have apparently paid. "Waste" has accordingly been eliminated; but this particular type of conservation program has cost the community millions of dollars in misdirected use of its labor and capital, it has cost the consumer an indeterminable amount by increasing the cost of petroleum products, and there is no convincing evidence that it has increased in any substantial measure the ultimate production of oil from the East Texas field.

But let us return to the contents of the book under review. It involves in preliminary chapters a brief historical sketch of the development of the oil industry in the United States, a consideration of the nature and origin of crude petroleum, a discussion of the laws governing the exploitation of oil and gas, the nature of oil production, and the

price-making influences in the industry, and devotes several chapters to the problem of stabilization. These all contain much useful information and some valuable analysis leading to the conclusion that stabilization, necessary though it is, must be attained by voluntary control:

> It is unconstitutional to compel property owners to combine their properties because it would be a restriction of liberty. . . . . Involuntary control is offensive to American ideals, repugnant to American institutions and repulsive to the individuals affected. . . . . The most practical method to control overproduction is through voluntary co-operation and control with the pool, instead of the lease, as the unit of production.

While the author is on sound ground, from either the individual or public point of view, in favoring the pool rather than the lease as the unit of operation, the essential to any real program of conservation is control over capacity to produce rather than mere control over output. On the whole, the author's discussion of stabilization in the oil industry may be expected to make more impervious to the public gaze the smoke screen of conservation with which the industry has frequently beclouded activities more certainly of a price-fixing nature.

GEORGE WARD STOCKING

UNIVERSITY OF TEXAS

BOOKS RECEIVED

Adams, James Truslow. *The March of Democracy. The Rise of the Union.* (New York: Charles Scribner's Sons, 1932.)

Blaisdell, Thomas C., Jr. *The Federal Trade Commission. An Experiment in the Control of Business.* (New York: Columbia University Press, 1932.)

Bye, Raymond T. *Principles of Economics.* (Rev. ed.) (New York: F. S. Crofts & Co., 1932.)

Coe, George A. *Educating for Citizenship. The Sovereign State as Ruler and as Teacher.* (New York: Charles Scribner's Sons, 1932.)

Cohen-Portheim, Paul. *The Discovery of Europe.* (New York: E. P. Dutton & Co., Inc., 1932.)

Cory, Helen May. *Compulsory Arbitration of International Disputes.* (New York: Columbia University Press, 1932.)

Daniels, Winthrop M. *American Railroads. Four Phases of Their History.* (Princeton: Princeton University Press, 1932.)

Douglas, Paul H. *The Coming of a New Party.* (New York: Whittlesey House, McGraw-Hill Book Co., Inc., 1932.)

Edie, Lionel D. *Economics: Principles and Problems.* (2d ed.; revised and reset.) (New York: Thomas Y. Crowell Co., 1932.)

Greenbaum, Edward S., and Reade, L.I. *The King's Bench Masters and English Inter-Locutory Practice.* (Baltimore: Johns Hopkins Press, 1932.)

International Industrial Relations Institute. *World Social Economic Planning.* (The Hague, 1932.)

Kerner, Robert Joseph. *Bohemia in the Eighteenth Century.* (New York: Macmillan Co., 1932.)

Kohn, Stanislas, and Meyendorff, Baron Alexander F. *The Cost of the War to Russia. The Vital Statistics of European Russia during the World War 1914–1917.* (New Haven: Yale University Press, 1932.)

Lange, Oskar. *Die Preisdispersion als Mittel zur statistischen Messung wirtschaftlicher Gleichgewichtsstörungen.* (Leipzig: Hans Buske, 1932.)

Lodge, Henry Cabot, Jr. *The Cult of Weakness.* (Boston: Houghton Mifflin Co., 1932.)

Malaparte, Curzio. (Translated by Sylvia Saunders.) *Coup d'Etat: The Technique of Revolution.* (New York: E. P. Dutton & Co., Inc., 1932.)

Mathews, John Mabry. *The American Constitutional System.* (New York: McGraw-Hill Book Co., Inc., 1932.)

Raver, Paul Jerome. *Recent Technological Developments and the Municipally Owned Power Plant.* (Chicago: Institute for Economic Research, 1932.)

Reichenau, Charlotte von. *Die Kapitalfunktion des Kredits.* (Jena: Gustav Fischer, 1932.)

Robbins, Lionel. *An Essay on the Nature & Significance of Economic Science.* (New York: Macmillan Co., 1932.)

Rodkey, R. G. *Preferred Stocks as Long-Term Investments.* ("Michigan Business Studies," Vol. IV.) (Ann Arbor: Bureau of Business Research, University of Michigan, 1932.)

Seligman, Edwin R. A., and Shoup, Carl S. *Informe Sobre el Sistema Tributario de Cuba.* (Havana: Talleres Tipograficos de Carasa y Cia, 1932.)

Smith, Raymond F. *Operating and Earning Power Ratios of Electric Companies.* (Bureau of Business Research Bulletin No. 42.) (Urbana: University of Illinois, 1932.)

Somary, Felix. *Krisenwende?* (Berlin: S. Fischer Verlag, 1932.)

Tryon, F. G., and Eckel, E. C. (ed.). *Mineral Economics. Lectures under the Auspices of the Brookings Institution.* (New York: McGraw-Hill Book Co., Inc., 1932.)

Wagemann, E. *Introduction à la théorie du mouvement des affaires.* (Paris: Librairie Félix Alcan, 1932.)

Westergaard, Harald. *Contributions to the History of Statistics.* (London: P. S. King & Son, Ltd., 1932.)

6